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DELETERIOUS EFFECT OF FUSING FLUIDS ON PRINTED WIRING BOARDS.(U)
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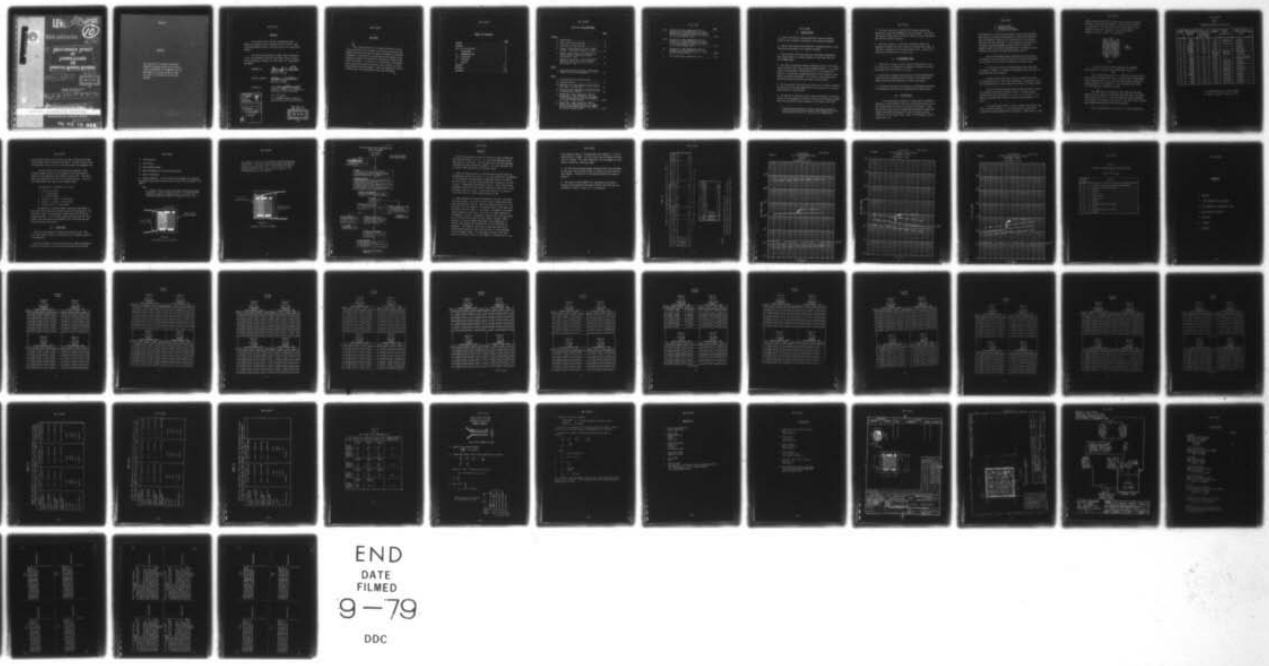

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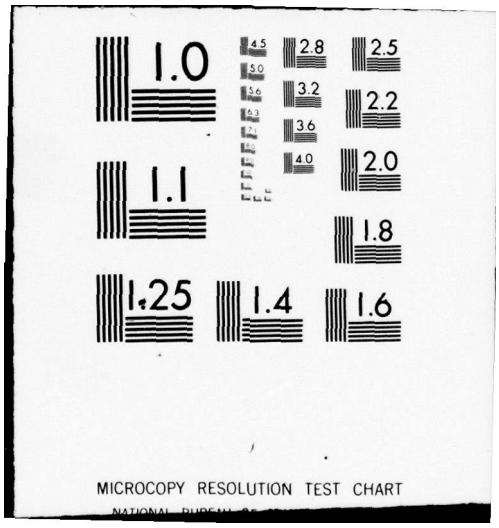
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MICROCOPY RESOLUTION TEST CHART

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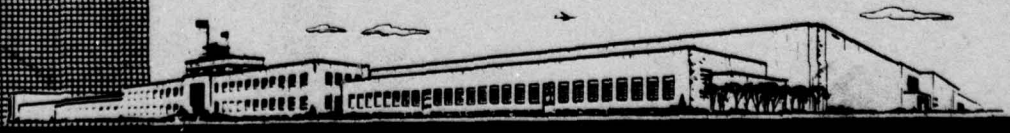

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PREFACE

This report covers the work performed by NAC's Materials Laboratory from 1 December 1978 to 30 April 1979 on the deleterious effect of fusing fluids on printed wiring boards.

This work was performed for RADC, under sponsorship of Mr. John McCormick, Rome Air Development Center's Reliability Laboratory, Griffiss Air Force Base, NY; FQ761070032 BCN 90474.

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ABSTRACT

This study identified the corrosive effects of fusing fluids and fusing fluid residues on printed wiring boards subjected to electrical stress in a humid environment at elevated temperature. The effect of varying delay times between solder fusing and cleaning of fusing fluid residues for three fusing fluids was studied. The effect of a single delay time between solder fusing and cleaning of fusing fluid residues for eight other fusing fluids was studied. Also, the protective value of a solder resist and a conformal coating was evaluated.

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LIST OF ILLUSTRATIONS

I. CONCLUSIONS

1. Seven of the fusing fluids tested had a minimal degrading effect on the insulation resistance of the prepared specimens.

2. Four of the fusing fluids tested had a degrading effect on the insulation resistance of the prepared specimens.

3. The insulation resistance testing of specimens contaminated with fusing fluids is a better measure of cleanliness than the MIL-P-28809 method.

4. The infra-red spectrophotometer characterization of the fusing fluids indicates that seven of them contained glycols. In a report[1] given at the September 1978 meeting of IPC, it was stated that glycols in fluxes have a degrading effect on the insulation resistance of printed-wiring boards. The results of this study do not confirm this when the glycols are used in fusing fluids.

5. The test results from the fusing fluids do not provide sufficient statistical data for the preparation of a first draft of a military specification on fusing fluids.

6. The analysis of variance (anova) testing performed on resistance values of the contaminated specimens indicated the difference between the 0 VDC and 100 VDC stress specimens is not always significant.

[1] *"Printed-Wiring Assembly Insulation Resistance Degradation Caused by Nonionizing Water-Soluble Flux Residues", Dr. Frank Zado, Western Electric Co., Princeton, NJ (UNPUBLISHED)*

7. The anova indicated a significant difference between the solder mask coated and conformally coated specimens. The solder mask material gave greater protection against moisture penetration than did the conformal coating.

8. The anova revealed a significant difference between the measured resistances for the 72 hour and 168 hour delay times for specimens contaminated with fusing fluids A and B. There was no significant difference with fusing fluid C.

II. RECOMMENDATIONS

1. Insulation resistance testing should be performed by a user of fusing fluids to determine the deleterious effect on printed-wiring boards of the fluids he is using.

2. Insulation resistance testing and not the MIL-P-28809 method should be used to determine the cleanliness of printed-wiring boards which have been subjected to fusing fluid usage.

3. Insulation resistance testing should be performed on printed-wiring boards which have been contaminated with known glycols.

III. DISCUSSION

In the electronics industry, a fusing fluid is generally defined as a heat-transfer liquid for fusing applications such as the reflow melting of solder on printed wiring boards. Since fusing fluids do not have to promote the wetting of a metal with solder, they would not necessarily have to contain the same chemicals as rosin based fluxes. Some of the chemicals in rosin based fluxes are:

1. Wetting agents
2. Oxidation removers
3. Reoxidation preventers

The question as to the corrosive effect of rosin based activated (RA) fluxes on printed wiring boards has already been addressed. Since the chemical composition of fusing fluids is not known by the user, the question arose: is the insulation resistance of a printed wiring board degraded by fusing fluids as they are presently used in electronics manufacturing? At present, fusing fluids are not under a military specification control.

Rome Air Development Center requested that NAC evaluate the effects of fusing fluids on printed wiring boards and prepare a first draft for a military specification on fusing fluids.

A literature survey was conducted before this experiment was started. However, it yielded no information about the type of experiment that was performed.

Sixteen fusing fluids were chosen at random from fusing fluid manufacturers for use in this experiment. Eleven were tested. The characterization of the sixteen fusing fluids is shown in Table I.

Eight of the eleven fusing fluids tested were water soluble. The remaining three were insoluble in water. The eight water soluble fluids were designated "A, B, C, J, L, M, N, and O". The three fluids which were insoluble in water were designated "F, I, and K".

The comb pattern shown in Figure 1 (page 4) was used as the basic resistance specimen. It was produced using conventional printed wiring board manufacturing techniques. Historically, a comb

pattern specimen has been associated with printed wiring board insulation resistance measurements. This particular pattern is a duplicate of the one used in the IPC Round Robin on the "Additive Process for Producing Printed Wiring Boards". (Dimensions on Dwg. AV22107 in the Appendix.)

COMB PATTERN

Figure 1.

A total of 325 comb pattern specimens was produced. Approximately 48 specimens were used for each test run.

Using resistance squares, 1.5×10^8 ohms insulation resistance on the comb pattern was found to be equivalent to 500 megohms on the trumpet pattern in MIL-P-55110C (equilibration calculation shown on page A-22 in the Appendix). Any resistance value below 1.5×10^8 ohms was considered a failure.

The experiment was designed so that some test specimens within a test set were very clean when they were ready for temperature and humidity stress. These specimens were used to determine if the copper clad laminate from which all the comb pattern specimens were produced contained any electrical anomalies.

The "Experiment Matrix", Table II, is a visual description

TABLE I.

CHARACTERIZATION OF FUSING FLUIDS

FUSING FLUID	*WATER EXTRACT RESISTIVITY OHM-CM	pH(0.1 ml of FLUID DILUTED W/ 50 ml H_2O)	% RESIDUE AT 500°F	CHLORIDE ION INDICATION	WATER SOLUBILITY 1 PART FLUID/4 PARTS H_2O
A	5600	4.1	7.52	Positive	Soluble
B	14300	4.4	0.69	Positive	Soluble
C	901300	5.6	3.92	?	Soluble
D	907000	4.8	3.84	?	Emulsion
E	156000	4.6	44.11	Negative	Insoluble
F	74670	**	64.53 @ 100°C	Negative	Insoluble
G	10150	4.2	10.79	?	Cloudy Solution
H	6650	3.7	6.08	Positive	Soluble
I	73300	5.9	68.50	Negative	Insoluble
J	6020	4.1	1.77	Positive	Soluble
K	71700	5.1	79.64	Negative	Insoluble
L	5300	4.1	1.69	Positive	Soluble
M	360000	5.5	3.24	Negative	Soluble
N	6750	4.1	6.20	Positive	Soluble
O	2950	3.6	3.22	Positive	Soluble
P	8270	4.0	3.37	Positive	Soluble

* Performed according to MIL-F-14256D

** Unable to obtain, insoluble in H_2O

TABLE II.

EXPERIMENT MATRIX
RESISTANCE READINGS DURING HUMIDITY & ELEVATED TEMPERATURE STRESSING
MIL-STD-810C, METHOD 507.1, PROCEDURE I.

SPECIMENS PER SET	A[1] 0[2] C[3] A100C AOS A100S 4 4 4 4	$R < 1.5 \times 10^8 \Omega$ DURING TESTING	BOC B100C BOC B100S 4 4 4 4	$R < 1.5 \times 10^8 \Omega$ DURING TESTING	COC C100C COS C100S 4 4 4 4	$R < 1.5 \times 10^8 \Omega$ DURING TESTING
DAYS	72 HOUR DELAY BEFORE FUSING FLUID REMOVAL					
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
DAYS	168 HOUR DELAY BEFORE FUSING FLUID REMOVAL					
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

[1] First letter indicates fusing fluid used.
[2] Number will either be 0(no DC voltage) or 100(DC volts).
[3] Last letter indicates conformal coated(C) or solder mask(S).

of how the experiment was designed. Those specimens within a test set were divided into lots which were then contaminated with the fusing fluids. Some test specimens within a fusing fluid lot were stressed with 100 volts DC, while other test specimens were not voltage stressed. Some test specimens within a fusing fluid lot were solder mask coated, while others were conformally coated. The test specimens which were tested for electrical anomalies were neither voltage stressed nor coated. Within each fusing fluid lot there were enough specimens provided to permit the data obtained to be analyzed statistically.

The fusing fluids were tested in groups of three for each test run. There was a total of 48 specimens for each group of three. This gave a possibility of five control specimens, since the maximum which would be loaded into the humidity chamber was 53 specimens.

The MIL-P-28809 Ionic Contaminants Test was used on a sampling basis to monitor boards from the same process lot for cleanliness. (These sampled boards were not temperature and humidity stressed.)

Time between fusing fluid fusing and cleaning was the variable chosen to differentiate between temperature and humidity stress runs for fusing fluids A, B, and C. The two delay times between fusing fluid fusing and cleaning were chosen to simulate fabrication cycles with 1) 72 hours standing over a weekend, or 2) 168 hours for boards touched up or otherwise held in process for one week. The remaining fusing fluids were subjected to a 72 hour delay time only.

The temperature and humidity conditions of MIL-STD-810C Environmental Test Methods, Method 507.1, Procedure I, were used.

This was done because fusing fluids are used to fabricate printed wiring boards used in electronic equipment. Ultimately the printed wiring boards survive or fail in the environment the equipment sees.

The resistances of the specimens were measured in the humidity chamber during the high temperature and high humidity portion of the temperature and humidity stress cycle. The resistances were measured on 24 hour cycles on working days. The resistance measurements were made using a megohm bridge.

The experiment proceeded in this order:

1. Fluids A, B, and C
   A. 72 hour delay
   B. 168 hour delay
2. Fluids F, I, and K - 72 hour delay
3. Fluids J, L, and O - 72 hour delay
4. Fluids M and N - 72 hour delay

An analysis of variance (anova) testing was performed to form conclusions about data collected during this experiment. The resistance values of the specimens contaminated with the fusing fluids were used. The resistance values used were from the third, seventh, and tenth days of measurement after initiating the test for each fusing fluid tested.

IV. PROCEDURE

1. Make 325 comb pattern printed wiring boards of FL-GF, .062 C 1/1 glass epoxy laminate to conform to Dwg. AV 22109 on page A-27 in the Appendix.

2. Mask the laminate, using dry film resist so that the conductor pattern and the back of the printed wiring board can be plated.

3. Tin/lead plate.

4. Strip resist.

5. Etch unplated copper.

6. Rinse thoroughly in tap water and blow dry.

7. Rout out specimens.

8. Prepare specimens. The flow chart and procedure for producing the water soluble and non-water soluble fusing fluid specimens is on page 11.

NOTE:

A. Figure 2 shows how the solder mask coated specimen was constructed. Solder mask was applied to the comb specimen which was governed by conductor pads 1, 2, and ½ of 3. Electrical leads were soldered to conductor pads 1 and 2.

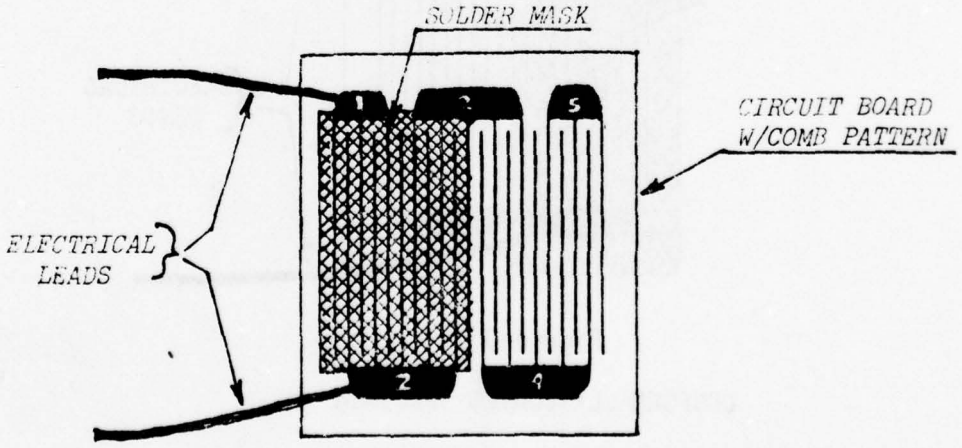


Figure 2.

SOLDER MASK COATED SPECIMEN

B. Figure 3 shows how the conformally coated specimen was constructed. Electrical leads were soldered to conductor pads 1 and 2. The leads exited the specimen from the end opposite conductor pads 1 and 2. This allowed the comb specimen governed by conductor pads 1, 2 and ½ of 3 to be conformally coated by dipping.

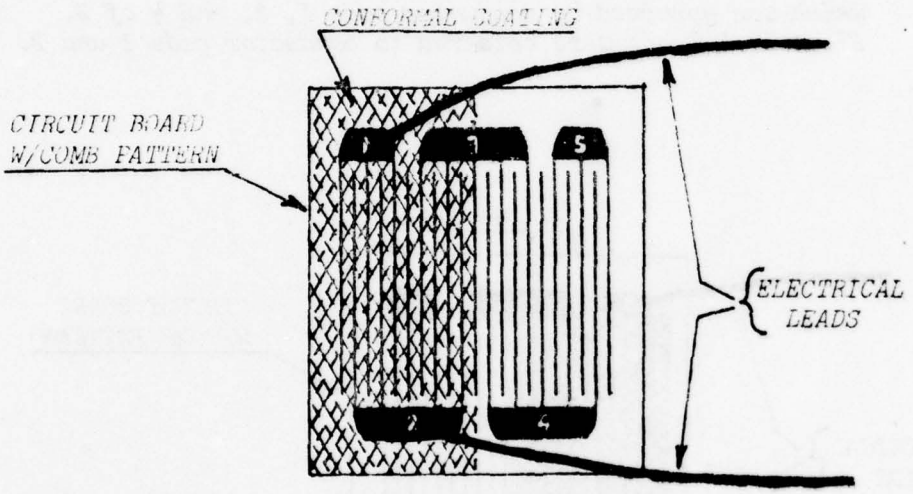
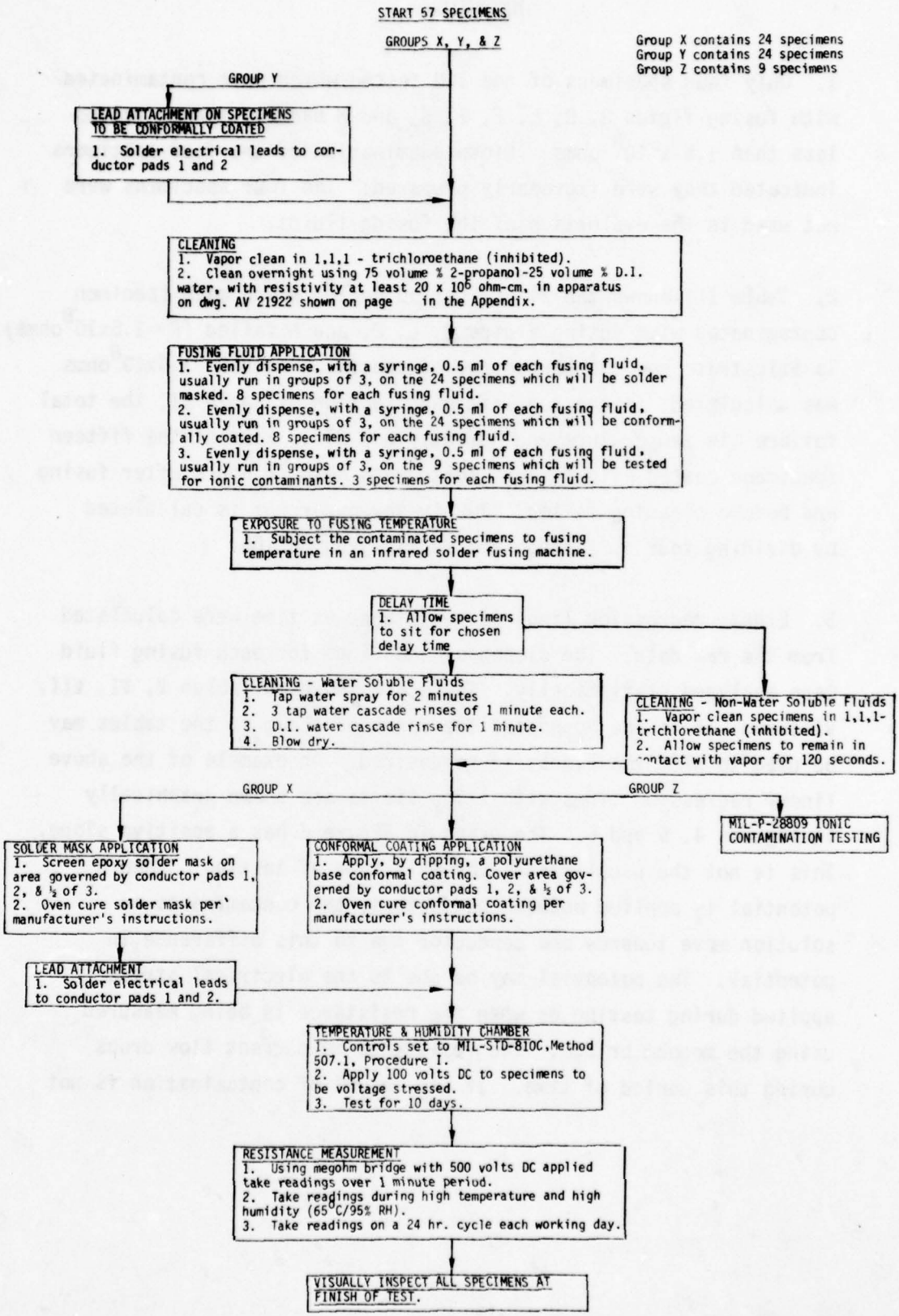


Figure 3.

CONFORMALLY COATED SPECIMEN

FLOW CHART FOR WATER SOLUBLE AND NON-WATER SOLUBLE FUSING FLUID SPECIMENS



RESULTS

1. Only four specimens of the 160 tested which were contaminated with fusing fluids A, B, C, F, I, K, and M had resistance values less than 1.5×10^8 ohms. Close examination of the four specimens indicated they were improperly prepared. The four specimens were not used in the evaluation of the fusing fluids.

2. Table III shows the 24 hr. period during which each specimen contaminated with fusing fluids J, L, O, and N failed ($R < 1.5 \times 10^8$ ohms). To illustrate how the percentage of specimens with $R < 1.5 \times 10^8$ ohms was calculated, in the top left hand section of Table III the total failure in temperature and humidity was 27%. Four of the fifteen specimens coated with fusing fluid J and held 72 hours after fusing and before cleaning failed. Twenty-seven percent is calculated by dividing four by fifteen and multiplying by 100.

3. Linear regression lines of resistance vs time were caluclated from the raw data. The slopes of the lines for each fusing fluid were analyzed statistically. These are shown on Tables V, VI, VII, VIII and IX in the Appendix. The formulas shown in the tables may be used to plot the lines, if so desired. An example of the above linear regression lines with $\pm 3\sigma_y$ limits are shown graphically in Figures 4, 5 and 6. The graph in Figure 6 has a positive slope. This is not the usual result for this type of testing. When a potential is applied between conductors, the contaminants in solution move towards one conductor due to this difference in potential. The potential may be due to the electrical stress applied during testing or when the resistance is being measured using the megohm bridge. The resistance to current flow drops during this period of time. If the amount of contamination is not

great enough to cause a "bridge"between the conductors, a resistance barrier is formed. This will cause the resistance to current flow to increase. The linear regression line calculated can then result in one with a positive slope.

4. An infra-red spectrophotometer characterization was performed on the eleven fusing fluids tested to identify the main constituents therein. The results of the characterization are shown in Table IV.

5. The values on MIL-P-28809 ionic contamination testing of fusing fluid contaminated specimens retained from each test run are shown in Table X., page A-21 in the Appendix.

TABLE III.

HUMIDITY & ELEVATED TEMPERATURE RESISTANCES LESS THAN 1.5 x 10^8 OHMS

MIL-STD-810C, METHOD 507.1, PROCEDURE 1.

DATE (1979)	DAY	J[1]	J100C	J 0S	J100S	Totals	P is less than 1.5x10^8ohms	L0C	L100C	L0S	L100S	Totals	R is less than 1.5x10^8ohms	O0C	O 100C	O0S	O 100S	Totals	R is less than 1.5x10^8ohms
		*3					72 Hour Delay Before Fusing Fluid Removal												
2 Apr	3	4						4						3	1				
3 Apr	4																		
4 Apr	5																		
5 Apr	6																		
6 Apr	7																		
9 Apr	10																		
TOTALS		4	0	0	0	4	27%	4	0	0	0	4	25%	3	1	0	0	4	25%

* ( ) Indicates number of specimens, 4 specimens were normally used.

DATE (1979)	DAY	N[1]	N100C	N0S	N100S	Totals	P is less than 1.5x10^8ohms
72 Hour Delay Before Fusing Fluid Removal							
23 Apr	3	4	2				
24 Apr	4						
25 Apr	5						
26 Apr	6						
27 Apr	7						
30 Apr	10						
TOTALS		4	2	0	0	6	38%

LEGEND:

[1] *First letter indicated fusing fluid used.*

[2] *Number will either be 0 (no DC voltage) or 100 (DC volts).*

[3] *Last letter indicates conformal coated (C) or solder mask (S).*

FIGURE 4. 72 HOUR DELAY
(A, B, AND C FUSING FLUIDS)
CONTROLS

RESISTANCE VS TIME

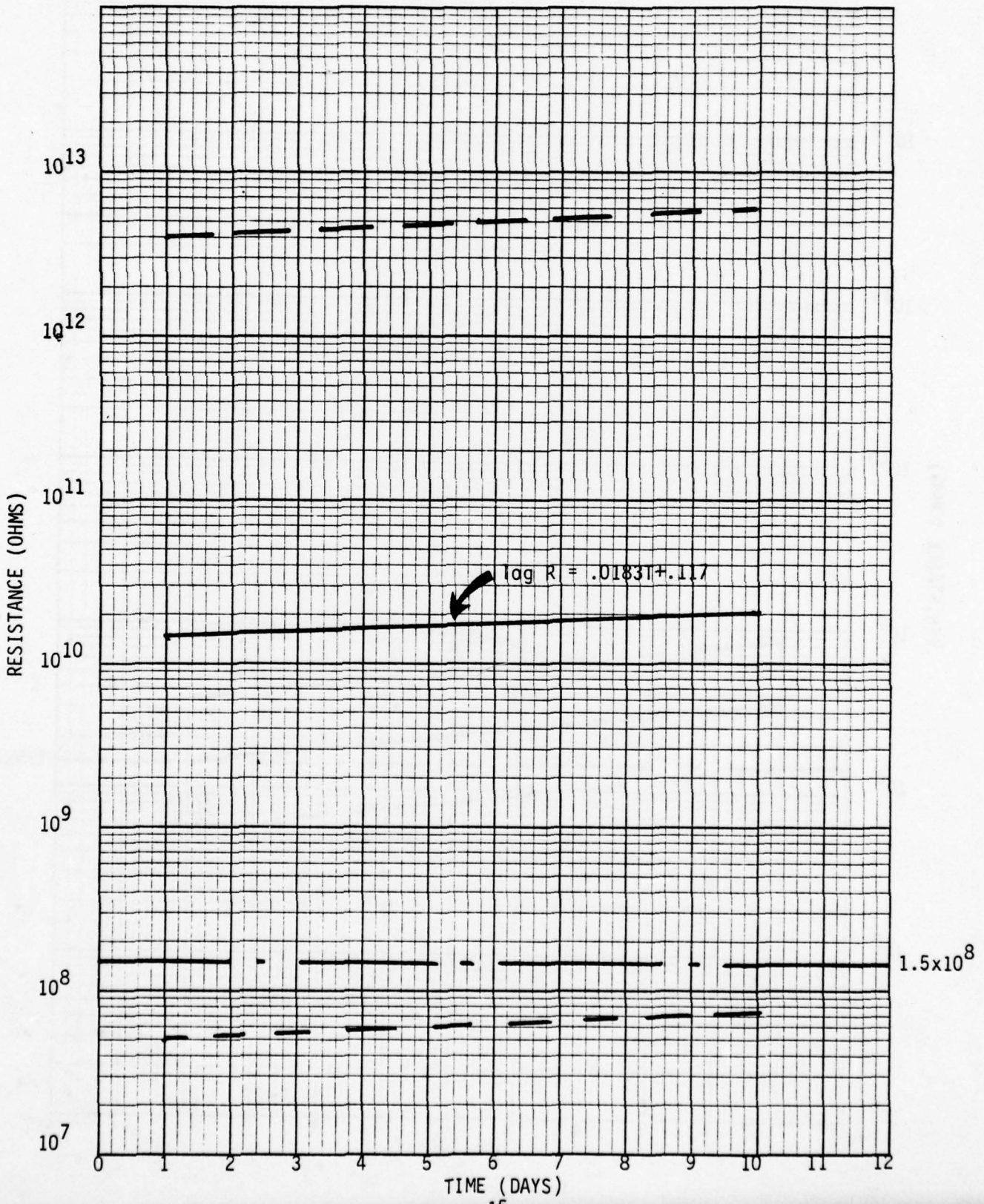


FIGURE 5. 72 HOUR DELAY
A FUSING FLUID, 0 VOLTS STRESS,
CONFORMALLY COATED

RESISTANCE VS TIME

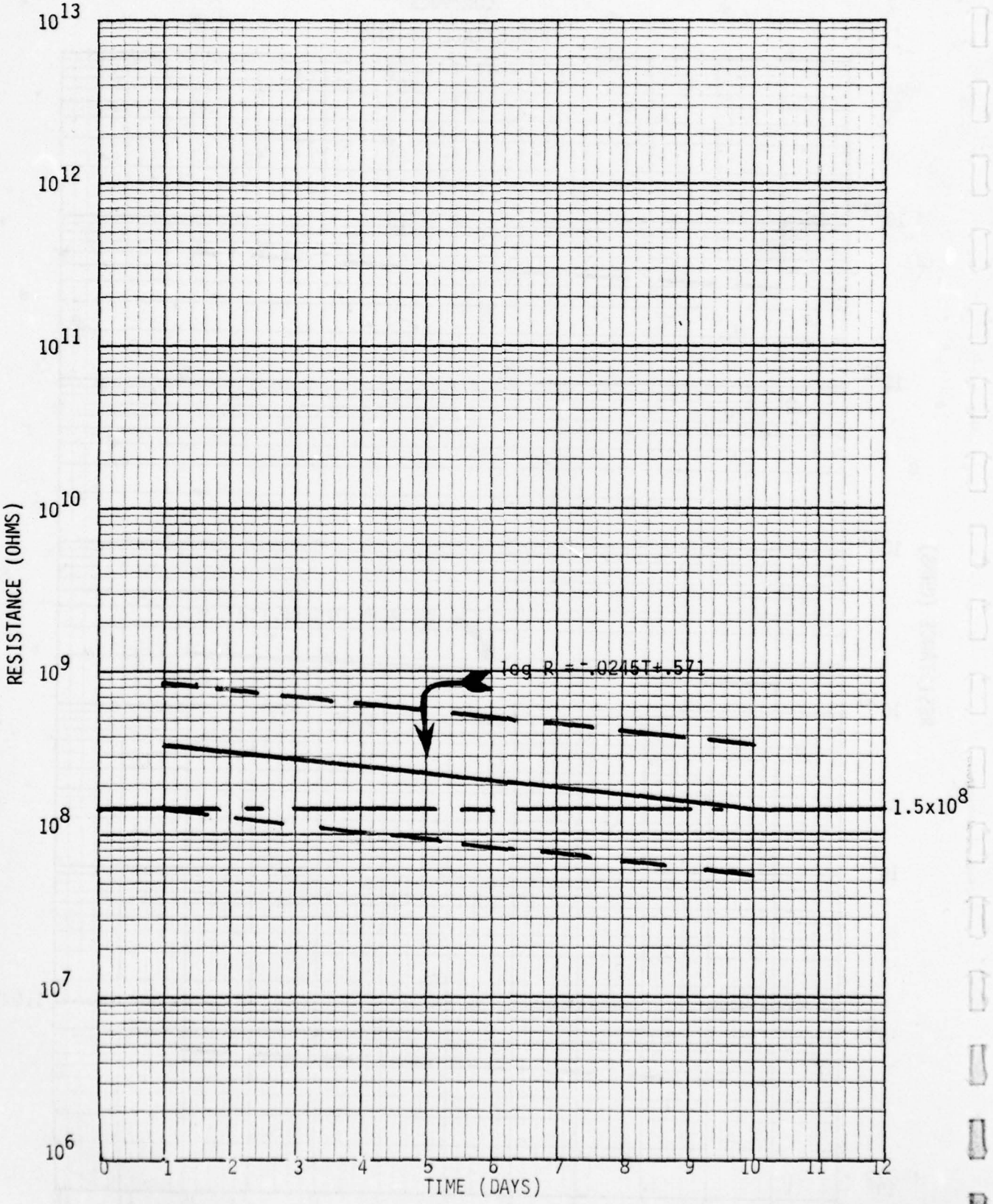


FIGURE 6. 72 HOUR DELAY
A FUSING FLUID, 100 VOLTS STRESS,
CONFORMALLY COATED

RESISTANCE VS TIME

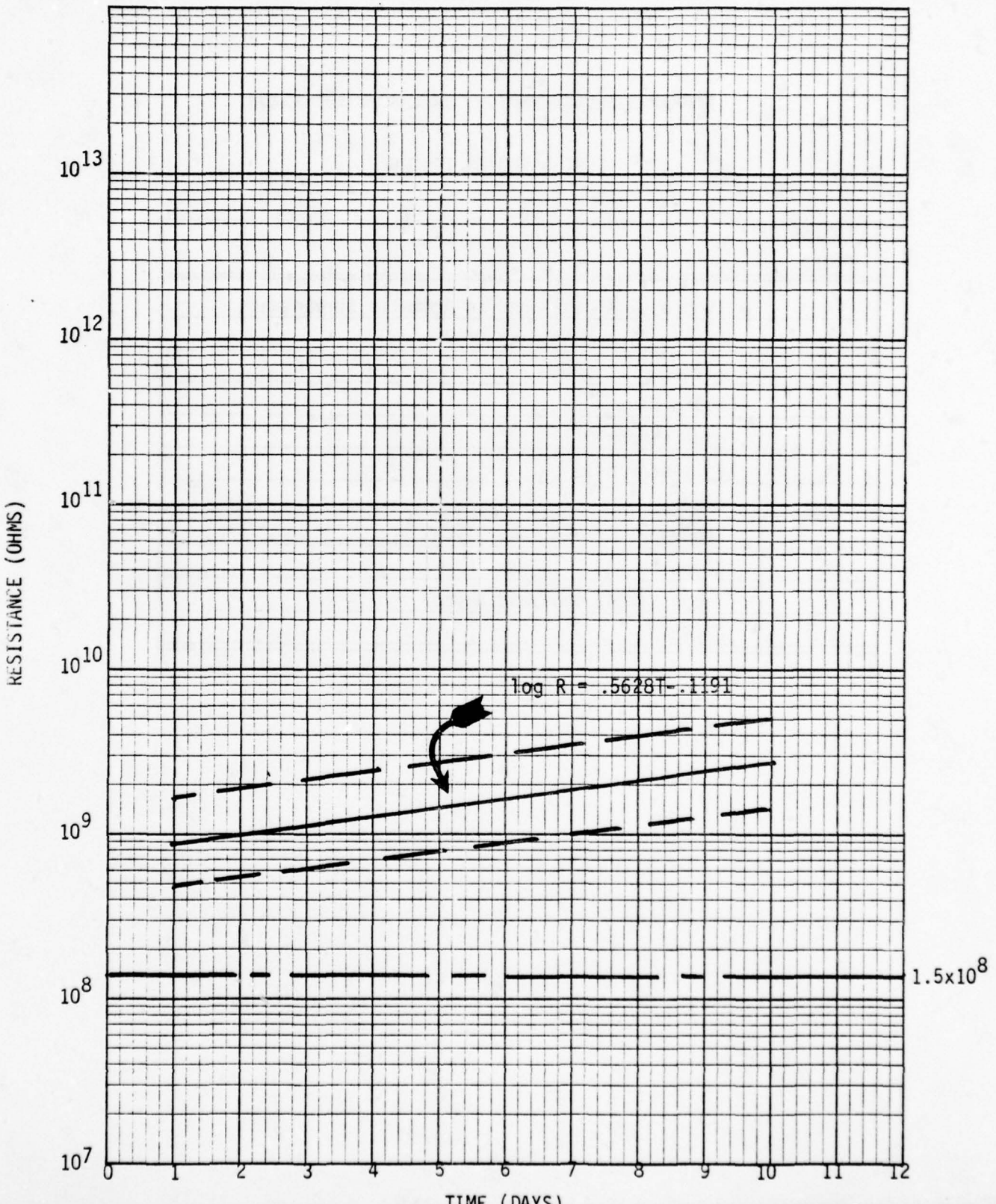


TABLE IV.

INFRA-RED SPECTROPHOTOMETER CHARACTERIZATION
OF
FUSING FLUIDS TESTED

FUSING FLUID	RESULTS
A	Isopropyl Alcohol and an Aromatic Surfactant
B	Isopropyl Alcohol and Glycol
C	Glycol
F	Rosin Flux
I	Hydrocarbon Oil
K	Polyester Oil
J	Glycol
L	Isopropyl Alcohol and Glycol
M	Glycol
N	Isopropyl Alcohol and Glycol
O	Glycol

APPENDIX

1. Raw Data
2. Linear Regression Line Formula
3. MIL-P-28809 Ionic Contaminants Test
4. Equilibration Calculation
5. Materials
6. Equipment
7. Drawings

NAC TR-2259
RAW DATA

FUSING FLUID
TYPE (A)
72 Hr. Delay
CONFORMAL COATED
0 VOLTS
Insulation Resistance - OHMS

DAY	Spec.1	Spec.2 *	Spec.3	Spec.4	Control#1
3	4.0×10^{8}	5.25×10^{8}	2.1×10^{8}	2.7×10^{8}	1.68×10^{11}
4	2.6×10^{8}	2.25×10^{8}	1.66×10^{8}	2×10^{8}	1.2×10^{11}
5	2.2×10^{8}	1.4×10^{8}	1.74×10^{8}	2.1×10^{8}	1.6×10^{11}
6	2.73×10^{8}	2.25×10^{8}	3.15×10^{8}	3.7×10^{8}	1.53×10^{11}
7	1.76×10^{8}	1.34×10^{8}	2×10^{8}	1.6×10^{8}	1.02×10^{11}
10	1.58×10^{8}	8.5×10^{7}	1.88×10^{8}	1.62×10^{8}	8.6×10^{10}

FUSING FLUID
TYPE (A)
72 Hr. Delay
CONFORMAL COATED
100 VOLTS
Insulation Resistance - OHMS

DAY	Spec.1	Spec.2	Spec.3	Spec.4
3	10.4×10^{8}	1.12×10^{9}	9.0×10^{8}	10.4×10^{8}
4	1.15×10^{9}	1.15×10^{9}	9.35×10^{8}	1.06×10^{9}
5	1.6×10^{9}	1.54×10^{9}	1.34×10^{9}	1.52×10^{9}
6	2.8×10^{9}	2.3×10^{9}	2.13×10^{9}	2.33×10^{9}
7	2.25×10^{9}	1.86×10^{9}	1.74×10^{9}	2×10^{9}
10	2.8×10^{9}	2.1×10^{9}	2.2×10^{9}	2.43×10^{9}

* Faulty Specimen

FUSING FLUID
TYPE (A)
72 Hr. Delay
SOLDER MASK
0 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4	Control #2
3	3.65×10^{10}	5.1×10^{10}	5.0×10^{10}	2.2×10^{10}	1.8×10^{9}
4	3×10^{10}	3.95×10^{10}	3.85×10^{10}	1.04×10^{10}	1.15×10^{9}
5	3.5×10^{10}	4.1×10^{10}	4.1×10^{10}	1.15×10^{10}	1.1×10^{9}
6	3.35×10^{10}	3.75×10^{10}	3.7×10^{10}	8.0×10^{9}	9×10^{8}
7	2.95×10^{10}	3.2×10^{10}	3.4×10^{10}	8.5×10^{9}	8.8×10^{8}
10	2.5×10^{10}	2.6×10^{10}	2.78×10^{10}	6.8×10^{9}	2.43×10^{10}

FUSING FLUID
TYPE (A)
72 Hr. Delay
SOLDER MASK
100 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4
3	3.75×10^{10}	3.35×10^{10}	1.1×10^{10}	3.4×10^{10}
4	3×10^{10}	2.45×10^{10}	6.85×10^{9}	2.6×10^{10}
5	3.3×10^{10}	2.9×10^{10}	8.85×10^{9}	2.85×10^{10}
6	2.83×10^{10}	2.23×10^{10}	9.6×10^{9}	2.25×10^{10}
7	2.8×10^{10}	2.3×10^{10}	1.1×10^{10}	2.4×10^{10}
10	2.2×10^{10}	1.42×10^{10}	2.2×10^{10}	2.2×10^{10}

RAW DATA

FUSING FLUID
TYPE (B)
72 Hr. Delay
CONFORMAL COATED
0 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4	Control#3
3	2.9×10^{9}	3.1×10^{9}	3.5×10^{9}	3.9×10^{9}	5.5×10^{10}
4	2.35×10^{9}	2.4×10^{9}	2.65×10^{9}	2.95×10^{9}	2.1×10^{10}
5	3.35×10^{9}	3.35×10^{9}	3.5×10^{9}	3.9×10^{9}	2.1×10^{10}
6	3.0×10^{9}	2.85×10^{9}	2.93×10^{9}	3.13×10^{9}	1.06×10^{10}
7	3.2×10^{9}	3.05×10^{9}	3.28×10^{9}	3.2×10^{9}	1.4×10^{10}
10	3.45×10^{9}	3.3×10^{9}	3.3×10^{9}	3.85×10^{9}	1.58×10^{10}

FUSING FLUID
TYPE (B)
72 Hr. Delay
CONFORMAL COATED
100 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4
3	5.25×10^{9}	5.25×10^{9}	5.4×10^{9}	5.5×10^{9}
4	3.8×10^{9}	4.7×10^{9}	4.6×10^{9}	4.7×10^{9}
5	6×10^{9}	6.4×10^{9}	6.3×10^{9}	6.35×10^{9}
6	4.93×10^{9}	5.3×10^{9}	5.2×10^{9}	5.1×10^{9}
7	6.4×10^{9}	7×10^{9}	6.85×10^{9}	6.85×10^{9}
10	7×10^{9}	8.5×10^{9}	7.9×10^{9}	9.1×10^{9}

FUSING FLUID
TYPE (B)
72 Hr. Delay
SOLDER MASK
0 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4
3	2.6×10^{10}	1.14×10^{10}	2.9×10^{10}	3.9×10^{10}
4	2.4×10^{10}	1.02×10^{10}	3.7×10^{9}	3.2×10^{10}
5	3.25×10^{10}	1.2×10^{10}	4×10^{9}	3.45×10^{10}
6	1.86×10^{10}	7.5×10^{9}	1.8×10^{10}	2.55×10^{10}
7	3×10^{10}	0.93×10^{10}	2.73×10^{10}	3×10^{10}
10	2.75×10^{10}	1×10^{10}	2.7×10^{10}	2.7×10^{10}

FUSING FLUID
TYPE (B)
72 Hr. Delay
SOLDER MASK
100 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4
3	4.25×10^{10}	4.5×10^{10}	4.9×10^{10}	5.9×10^{9}
4	2.75×10^{10}	3.5×10^{10}	4×10^{10}	1.5×10^{10}
5	1.6×10^{10}	3.4×10^{10}	4×10^{10}	5.2×10^{9}
6	1.15×10^{10}	2×10^{10}	3.1×10^{10}	4.6×10^{9}
7	2.15×10^{10}	2.85×10^{10}	3.25×10^{10}	2.7×10^{9}
10	2.55×10^{10}	2.45×10^{10}	3.2×10^{10}	1.86×10^{10}

FUSING FLUID
TYPE (C)
72 Hr. Delay
CONFORMAL COATED
0 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4
3	4.35×10^{11}	2.35×10^{11}	4.0×10^{11}	4.85×10^{11}
4	3.7×10^{11}	2.25×10^{11}	3.4×10^{11}	3.9×10^{11}
5	3.6×10^{11}	2.8×10^{11}	3.15×10^{11}	3.7×10^{11}
6	2.65×10^{11}	1.53×10^{11}	2.33×10^{11}	2.7×10^{11}
7	2.65×10^{11}	1.7×10^{11}	2.3×10^{11}	2.3×10^{11}
10	2.25×10^{11}	1.6×10^{11}	1.9×10^{11}	2.2×10^{11}

FUSING FLUID
TYPE (C)
72 Hr. Delay
CONFORMAL COATED
100 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4
3	4.25×10^{11}	3.75×10^{10}	8.6×10^{10}	4.5×10^{11}
4	3.3×10^{11}	2×10^{10}	4.35×10^{10}	2.95×10^{11}
5	3.15×10^{11}	8×10^{10}	4.35×10^{10}	3.5×10^{11}
6	2.13×10^{11}	8.4×10^{10}	3.45×10^{10}	2.57×10^{11}
7	1.94×10^{11}	9.5×10^{10}	5×10^{10}	2.57×10^{11}
10	1.62×10^{11}	6.7×10^{10}	2.2×10^{10}	2×10^{11}

FUSING FLUID
TYPE (C)
72 Hr. Delay
SOLDER MASK
0 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4
3	2.05×10^{11}	2.9×10^{11}	1.9×10^{11}	1.6×10^{11}
4	1.48×10^{11}	2.2×10^{11}	1.56×10^{11}	1.2×10^{11}
5	1.32×10^{11}	1.95×10^{11}	1.3×10^{11}	1.13×10^{11}
6	1×10^{11}	1.46×10^{11}	9.6×10^{10}	8.8×10^{10}
7	0.94×10^{11}	1.38×10^{11}	9.2×10^{11}	8.4×10^{10}
10	6.85×10^{10}	0.97×10^{11}	6.1×10^{10}	6×10^{10}

FUSING FLUID
TYPE (C)
72 Hr. Delay
SOLDER MASK
100 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4
3	1.62×10^{11}	5.8×10^{10}	5×10^{10}	6.65×10^{10}
4	1.26×10^{11}	7.35×10^{10}	5.2×10^{10}	2.7×10^{10}
5	1.1×10^{11}	6×10^{10}	3.8×10^{10}	5.5×10^{10}
6	8.4×10^{10}	5.5×10^{10}	3.3×10^{10}	3.7×10^{10}
7	8.1×10^{10}	4.6×10^{10}	3.4×10^{10}	4.1×10^{10}
10	5.9×10^{10}	3.65×10^{10}	2.35×10^{10}	4.5×10^{10}

FUSING FLUID
TYPE (A)
168 Hr. Delay
CONFORMAL COATED
0 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4	Control#1
1	1.2×10^{9}	1.7×10^{9}	4.4×10^{9}	5.2×10^{9}	4×10^{10}
2	0.96×10^{9}	1.2×10^{9}	2.6×10^{9}	4.6×10^{10}	3.3×10^{10}
3	1.3×10^{9}	1.52×10^{9}	2.8×10^{9}	6.9×10^{9}	3.3×10^{10}
7	1.03×10^{9}	1.4×10^{9}	1.27×10^{9}	3.3×10^{9}	8.5×10^{9}
8	8.8×10^{9}	9.6×10^{9}	9×10^{9}	1.64×10^{10}	4.85×10^{10}
9	3.25×10^{9}	2.45×10^{9}	3.4×10^{9}	9.4×10^{9}	9.4×10^{9}
10	1.9×10^{9}	1.8×10^{9}	2.55×10^{9}	6.6×10^{9}	7.2×10^{9}

FUSING FLUID
TYPE (A)
168 Hr. Delay
CONFORMAL COATED
100 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4
1	6.5×10^{9}	1.18×10^{10}	5.7×10^{9}	6.3×10^{9}
2	6×10^{9}	8.8×10^{9}	8.5×10^{9}	6.7×10^{9}
3	7.5×10^{9}	1×10^{10}	1.02×10^{10}	8.9×10^{9}
7	3.3×10^{9}	2.75×10^{9}	3.7×10^{9}	3×10^{9}
8	1.86×10^{10}	2.1×10^{10}	2.25×10^{10}	2.1×10^{10}
9	8.5×10^{9}	9.7×10^{9}	1.09×10^{10}	$.98\times10^{10}$
10	6.1×10^{9}	7×10^{9}	8×10^{9}	7×10^{9}

FUSING FLUID
TYPE (A)
168 Hr. Delay
SOLDER MASK
0 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4	Control#2
1	2.8×10^{11}	2.8×10^{11}	2.4×10^{11}	2.1×10^{11}	2.9×10^{11}
2	1.4×10^{11}	1.1×10^{11}	9×10^{10}	9.6×10^{10}	1.37×10^{11}
3	7.8×10^{10}	8.1×10^{10}	6.6×10^{10}	7.4×10^{10}	8.3×10^{10}
7	1.22×10^{10}	1.18×10^{10}	1.02×10^{10}	1×10^{10}	1.2×10^{10}
8	2.45×10^{10}	2.4×10^{10}	2.1×10^{10}	2.6×10^{10}	2.6×10^{10}
9	1.44×10^{10}	1.4×10^{10}	1.2×10^{10}	1.5×10^{10}	1.64×10^{10}
10	9.9×10^{9}	9.6×10^{9}	8.25×10^{9}	1.04×10^{10}	1.24×10^{10}

FUSING FLUID
TYPE (A)
168 Hr. Delay
SOLDER MASK
100 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4
1	1.2×10^{11}	9.5×10^{10}	9.6×10^{10}	9×10^{10}
2	6.2×10^{10}	6×10^{10}	6.2×10^{10}	5.7×10^{10}
3	5×10^{10}	5.4×10^{10}	5.2×10^{10}	5.1×10^{10}
7	6×10^{9}	7×10^{9}	5.8×10^{9}	5.7×10^{9}
8	2.1×10^{10}	2.2×10^{10}	1.92×10^{10}	2×10^{10}
9	1.05×10^{10}	1.08×10^{10}	$.93\times10^{10}$	$.96\times10^{10}$
10	7.8×10^{9}	8.2×10^{9}	6.75×10^{9}	6.65×10^{9}

FUSING FLUID
TYPE (B)
168 Hr. Delay
CONFORMAL COATED
0 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4	Control#3
1	4.6×10^{9}	1.6×10^{9}	5.9×10^{8}	2.7×10^{9}	7.6×10^{10}
2	3.9×10^{9}	1.4×10^{9}	5.9×10^{8}	3.2×10^{9}	5.5×10^{10}
3	6.8×10^{9}	4.4×10^{9}	1.8×10^{9}	5.5×10^{9}	6×10^{10}
7	1.22×10^{9}	6.3×10^{8}	3.3×10^{8}	6.5×10^{8}	9×10^{10}
8	1.6×10^{10}	1.4×10^{10}	1.17×10^{10}	1.18×10^{10}	3.8×10^{11}
9	6.25×10^{9}	5.5×10^{9}	3.85×10^{9}	3.75×10^{9}	1.06×10^{11}
10	4.4×10^{9}	3.8×10^{9}	2.45×10^{9}	2.65×10^{9}	6.7×10^{10}

FUSING FLUID
TYPE (B)
168 Hr. Delay
CONFORMAL COATED
100 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4
1	2.1×10^{9}	2.8×10^{9}	4.4×10^{9}	2.1×10^{9}
2	2.4×10^{9}	3.5×10^{9}	5.7×10^{9}	2.6×10^{9}
3	4×10^{9}	5.3×10^{9}	7.7×10^{9}	3.5×10^{9}
7	1.18×10^{9}	1.52×10^{9}	1.88×10^{9}	1.07×10^{9}
8	1.55×10^{10}	1.76×10^{10}	1.64×10^{10}	1.45×10^{10}
9	5.5×10^{9}	6.4×10^{9}	6.4×10^{9}	5×10^{9}
10	3.4×10^{9}	4.2×10^{9}	4.4×10^{9}	3.1×10^{9}

FUSING FLUID
TYPE (B)
168 Hr. Delay
SOLDER MASK
0 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4	Control#4
1	2.4×10^{11}	2.4×10^{11}	2.5×10^{11}	4.7×10^{10}	9.3×10^{10}
2	1.05×10^{11}	1.24×10^{11}	1.32×10^{11}	3.25×10^{10}	8.6×10^{10}
3	8.5×10^{10}	0.99×10^{11}	1.04×10^{11}	3.1×10^{10}	7.9×10^{10}
7	8.6×10^{9}	8.75×10^{9}	9.5×10^{9}	5.25×10^{9}	5×10^{10}
8	4.6×10^{10}	5.4×10^{10}	6×10^{10}	4.8×10^{10}	1.1×10^{12}
9	2×10^{10}	2.35×10^{10}	2.6×10^{10}	1.77×10^{10}	1.12×10^{11}
10	1.32×10^{10}	1.52×10^{10}	1.68×10^{10}	1.12×10^{10}	6.5×10^{10}

FUSING FLUID
TYPE (B)
168 Hr. Delay
SOLDER MASK
100 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4
1	1.8×10^{11}	1.6×10^{11}	1.08×10^{11}	1.56×10^{11}
2	9×10^{10}	8.7×10^{10}	8.9×10^{10}	1.14×10^{11}
3	7×10^{10}	6.2×10^{10}	6.8×10^{10}	8.6×10^{10}
7	8.5×10^{9}	8.5×10^{9}	8.4×10^{9}	10×10^{9}
8	6.1×10^{10}	4.6×10^{10}	5.5×10^{10}	6.75×10^{10}
9	2.3×10^{10}	2×10^{10}	2.15×10^{10}	2.6×10^{10}
10	1.57×10^{10}	1.35×10^{10}	1.52×10^{10}	1.8×10^{10}

FUSING FLUID
TYPE (C)
168 Hr. Delay
CONFORMAL COATED
0 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4
1	1.86×10^{12}	5.6×10^{11}	1.24×10^{12}	6.3×10^{10}
2	1.2×10^{12}	6.4×10^{11}	9×10^{11}	6.5×10^{10}
3	9.9×10^{11}	8.6×10^{11}	8×10^{11}	7.3×10^{10}
7	1.13×10^{11}	1.23×10^{11}	1.24×10^{11}	0.97×10^{11}
8	5.5×10^{11}	5.9×10^{11}	5.75×10^{11}	5.1×10^{11}
9	2.65×10^{11}	2.7×10^{11}	2.75×10^{11}	2.15×10^{11}
10	1.85×10^{11}	2.1×10^{11}	1.97×10^{11}	1.6×10^{11}

FUSING FLUID
TYPE (C)
168 Hr. Delay
CONFORMAL COATED
100 VOLTS
Insulation Resistance - OHMS

Spec. 1	Spec. 2	Spec. 3	Spec. 4
5.4×10^{10}	6.7×10^{10}	1.34×10^{12}	1.84×10^{12}
1.74×10^{11}	2.9×10^{11}	8.5×10^{11}	1.3×10^{12}
3.3×10^{11}	5.5×10^{11}	7×10^{11}	8.8×10^{11}
1.35×10^{11}	1.25×10^{11}	1.7×10^{11}	1.5×10^{11}
5.5×10^{11}	5.6×10^{11}	6.4×10^{11}	6.1×10^{11}
2.75×10^{11}	2.6×10^{11}	3.25×10^{11}	3.1×10^{11}
1.92×10^{11}	1.72×10^{11}	2.25×10^{11}	2.1×10^{11}

FUSING FLUID
TYPE (C)
168 Hr. Delay
SOLDER MASK
0 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4
1	0.97×10^{12}	1.09×10^{12}	1.2×10^{12}	1.07×10^{12}
2	5.6×10^{11}	5.8×10^{11}	5.8×10^{11}	5.3×10^{11}
3	3.4×10^{11}	3.3×10^{11}	3.5×10^{11}	3.2×10^{11}
7	4×10^{10}	3.4×10^{10}	3.9×10^{10}	3.5×10^{10}
8	1.54×10^{11}	1.27×10^{11}	1.32×10^{11}	1.26×10^{11}
9	7.2×10^{10}	4.85×10^{10}	6.3×10^{10}	5.7×10^{10}
10	5.3×10^{10}	3.5×10^{10}	4.4×10^{10}	4×10^{10}

FUSING FLUID
TYPE (C)
168 Hr. Delay
SOLDER MASK
100 VOLTS
Insulation Resistance - OHMS

Spec. 1	Spec. 2	Spec. 3	Spec. 4
8.6×10^{11}	7.2×10^{11}	7.5×10^{11}	2.25×10^{11}
4.5×10^{11}	3.5×10^{11}	3.7×10^{11}	1.1×10^{10}
2.4×10^{11}	$1.68.10^{11}$	1.7×10^{11}	1.4×10^{10}
3.45×10^{10}	2.65×10^{10}	3×10^{10}	2.45×10^{10}
1.06×10^{11}	6×10^{10}	6.8×10^{10}	5×10^{10}
4.4×10^{10}	1.9×10^{10}	2.2×10^{10}	1.25×10^{10}
3.15×10^{10}	1.4×10^{10}	1.66×10^{10}	1.03×10^{10}

RAW DATA

FUSING FLUID
TYPE (F)
72 Hr. Delay
CONFORMAL COATED
0 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4	Control#1
3	$7x10^{10}$	$6.1x10^{10}$	$7.9x10^{10}$	$5.8x10^{10}$	$1.79x10^{10}$
4	$4.45x10^{10}$	$3.9x10^{10}$	$4.5x10^{10}$	$3.6x10^{10}$	$1.06x10^{10}$
5	$3.35x10^{10}$	$2.9x10^{10}$	$3.1x10^{10}$	$2.55x10^{10}$	$7.7x10^{9}$
6	$2.7x10^{10}$	$2.25x10^{10}$	$2.35x10^{10}$	$1.96x10^{10}$	$6x10^{9}$
7	$2.5x10^{10}$	$2x10^{10}$	$1.96x10^{10}$	$1.7x10^{10}$	$5.4x10^{9}$
10	$1.66x10^{10}$	$1.36x10^{10}$	$1.38x10^{10}$	$1.2x10^{10}$	$4.05x10^{9}$

FUSING FLUID
TYPE (F)
72 Hr. Delay
CONFORMAL COATED
100 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4
3	$5.7x10^{10}$	$6.3x10^{10}$	$6.6x10^{10}$	$5.5x10^{10}$
4	$3.65x10^{10}$	$3.65x10^{10}$	$4x10^{10}$	$3.25x10^{10}$
5	$2.8x10^{10}$	$2.6x10^{10}$	$2.8x10^{10}$	$2.3x10^{10}$
6	$2.1x10^{10}$	$1.92x10^{10}$	$2.2x10^{10}$	$1.78x10^{10}$
7	$1.84x10^{10}$	$1.64x10^{10}$	$1.84x10^{10}$	$1.48x10^{10}$
10	$1.5x10^{10}$	$1.4x10^{10}$	$1.56x10^{10}$	$1.2x10^{10}$

FUSING FLUID
TYPE (F)
72 Hr. Delay
SOLDER MASK
0 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4	Control#2
3	$6.4x10^{11}$	$2.95x10^{10}$	$3.85x10^{10}$	$2.2x10^{10}$	$2.55x10^{10}$
4	$1.62x10^{11}$	$1.98x10^{10}$	$2.55x10^{10}$	$1.28x10^{10}$	$1.58x10^{10}$
5	$8.1x10^{10}$	$1.52x10^{10}$	$1.88x10^{10}$	$5.4x10^{9}$	$1.18x10^{10}$
6	$6.2x10^{10}$	$1.2x10^{10}$	$1.52x10^{10}$	$3.15x10^{9}$	$9.5x10^{9}$
7	$4.95x10^{10}$	$1.04x10^{10}$	$1.28x10^{10}$	$2.75x10^{9}$	$8x10^{9}$
10	$5.6x10^{10}$	$8.9x10^{9}$	$1.06x10^{10}$	$2.7x10^{9}$	$5.7x10^{9}$

FUSING FLUID
TYPE (F)
72 Hr. Delay
SOLDER MASK
100 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4*
3	$3.75x10^{10}$	$3.6x10^{10}$	$4.65x10^{10}$	$7.8x10^{8}$
4	$2.43x10^{10}$	$2.37x10^{10}$	$2.75x10^{10}$	$9.8x10^{8}$
5	$1.9x10^{10}$	$1.82x10^{10}$	$1.98x10^{10}$	$8.2x10^{8}$
6	$1.5x10^{10}$	$1.46x10^{10}$	$1.56x10^{10}$	$6.6x10^{8}$
7	$1.3x10^{10}$	$1.26x10^{10}$	$1.3x10^{10}$	$7x10^{8}$
10	$1.08x10^{10}$	$1.06x10^{10}$	$1.1x10^{10}$	$8.6x10^{8}$

* Faulty Specimen

FUSING FLUID
TYPE (I)
72 Hr. Delay
CONFORMAL COATED
0 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4
3	2.45×10^{10}	5.5×10^{10}	6.1×10^{10}	4.95×10^{10}
4	9.4×10^{9}	3.4×10^{10}	3.6×10^{10}	2.95×10^{10}
5	6.2×10^{9}	2.5×10^{10}	2.6×10^{10}	2.08×10^{10}
6	5.02×10^{9}	1.8×10^{10}	1.95×10^{10}	1.55×10^{10}
7	4.55×10^{9}	1.52×10^{10}	1.57×10^{10}	1.19×10^{10}
10	5.25×10^{9}	1.11×10^{10}	1.18×10^{10}	8.7×10^{9}

FUSING FLUID
TYPE (I)
72 Hr. Delay
CONFORMAL COATED
100 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4
3	5.7×10^{10}	4.8×10^{10}	5.3×10^{10}	2.8×10^{10}
4	3.6×10^{10}	2.95×10^{10}	3.1×10^{10}	1.5×10^{10}
5	2.65×10^{10}	2.12×10^{10}	2.24×10^{10}	1.36×10^{10}
6	2.0×10^{10}	1.64×10^{10}	1.78×10^{10}	1.16×10^{10}
7	1.76×10^{10}	1.4×10^{10}	1.5×10^{10}	9.95×10^{9}
10	1.45×10^{10}	1.11×10^{10}	1.18×10^{10}	6.3×10^{9}

FUSING FLUID
TYPE (I)
72 Hr. Delay
SOLDER MASK
0 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4
3	2.45×10^{10}	2.05×10^{10}	1.62×10^{10}	4.05×10^{10}
4	1.7×10^{10}	1.42×10^{10}	11.4×10^{9}	2.75×10^{10}
5	1.27×10^{10}	10.2×10^{9}	8.5×10^{9}	2.0×10^{10}
6	9.8×10^{9}	8.1×10^{9}	6.7×10^{9}	1.56×10^{10}
7	8.3×10^{9}	6.7×10^{9}	5.6×10^{9}	1.27×10^{10}
10	6.65×10^{9}	5.5×10^{9}	4.7×10^{9}	9.75×10^{9}

FUSING FLUID
TYPE (I)
72 Hr. Delay
SOLDER MASK
100 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4
3	3.8×10^{10}	4.3×10^{10}	3.2×10^{10}	2.85×10^{10}
4	2.6×10^{10}	2.95×10^{10}	2.2×10^{10}	2.0×10^{10}
5	2.0×10^{10}	2.24×10^{10}	1.66×10^{10}	1.52×10^{10}
6	1.64×10^{10}	1.87×10^{10}	1.41×10^{10}	1.27×10^{10}
7	1.44×10^{10}	1.62×10^{10}	1.23×10^{10}	1.1×10^{10}
10	1.17×10^{10}	1.29×10^{10}	10.0×10^{9}	8.9×10^{9}

FUSING FLUID
TYPE (K)
72 Hr. Delay
CONFORMAL COATED
0 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4
3	3.5×10^{10}	7.5×10^{10}		1.32×10^{11}
4	9.9×10^{9}	4.9×10^{10}		7.8×10^{10}
5	5.35×10^{9}	3.6×10^{10}		5.55×10^{10}
6	1.6×10^{10}	2.75×10^{10}		4.15×10^{10}
7	1.38×10^{10}	2.25×10^{10}		3.35×10^{10}
10	1.19×10	1.57×10^{10}		2.3×10^{10}

FUSING FLUID
TYPE (K)
72 Hr. Delay
CONFORMAL COATED
100 VOLTS
Insulation Resistance - OHMS

Spec. 1	Spec. 2	Spec. 3	Spec. 4
9.7×10^{10}	1.02×10^{11}	1.06×10^{11}	1.22×10^{11}
5.7×10^{10}	6.0×10^{10}	6.4×10^{10}	7.0×10^{10}
4.0×10^{10}	4.2×10^{10}	4.55×10^{10}	4.9×10^{10}
3.0×10^{10}	3.2×10^{10}	3.5×10^{10}	3.6×10^{10}
2.5×10^{10}	2.58×10^{10}	2.85×10^{10}	2.9×10^{10}
1.73×10^{10}	1.89×10^{10}	2.08×10^{10}	2.12×10^{10}

FUSING FLUID
TYPE (K)
72 Hr. Delay
SOLDER MASK
0 VOLTS
Insulation Resistance - OHMS

	Spec. 1	Spec. 2	Spec. 3	Spec. 4 *
3	4.4×10^{10}	4.35×10^{10}	3.9×10^{10}	7.7×10^{8}
4	2.95×10^{10}	2.90×10^{10}	2.7×10^{10}	2.6×10^{9}
5	2.2×10^{10}	2.22×10^{10}	2.06×10^{10}	2.45×10^{9}
6	1.7×10^{10}	1.74×10^{10}	1.65×10^{10}	2.3×10^{9}
7	1.44×10^{10}	1.46×10^{10}	1.39×10^{10}	1.6×10^{9}
10	1.06×10^{10}	1.11×10^{10}	1.05×10^{10}	1.75×10^{9}

FUSING FLUID
TYPE (K)
72 Hr. Delay
SOLDER MASK
100 VOLTS
Insulation Resistance - OHMS

Spec. 1	Spec. 2*	Spec. 3	Spec. 4
3.25×10^{10}	6.2×10^{8}	1.7×10^{10}	4.6×10^{10}
1.48×10^{10}	6.6×10^{8}	14.4×10^{9}	2.95×10^{10}
1.68×10^{10}	4.6×10^{8}	1.24×10^{10}	2.22×10^{10}
1.49×10^{10}	6.1×10^{8}	1.05×10^{10}	1.78×10^{10}
1.32×10^{10}	4.05×10^{8}	9.1×10^{9}	1.48×10^{10}
10.1×10^{9}	4.75×10^{8}	7.75×10^{9}	1.14×10^{10}

* FAULTY SPECIMEN

RAW DATA

FUSING FLUID
TYPE (J)
72 Hr. Delay
CONFORMAL COATED
0 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4	Control#1
3	4.95×10^{7}	7×10^{7}	4.4×10^{7}	3.6×10^{7}	3.15×10^{10}
4	1.2×10^{8}	1.14×10^{8}	9.7×10^{7}	7.5×10^{7}	2.85×10^{10}
5	8.8×10^{7}	1.36×10^{8}	5.7×10^{7}	7×10^{7}	1.52×10^{10}
6	1.08×10^{8}	1.2×10^{8}	9×10^{7}	7.6×10^{7}	1.76×10^{10}
7	1.46×10^{8}	1.48×10^{8}	1.03×10^{8}	1.06×10^{8}	1.42×10^{10}
10	2.2×10^{8}	2.05×10^{8}	2.2×10^{8}	1.96×10^{8}	1.28×10^{10}

FUSING FLUID
TYPE (J)
72 Hr. Delay
CONFORMAL COATED
100 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4
3	1×10^{9}	1.18×10^{9}	1.2×10^{9}	7.3×10^{8}
4	1.8×10^{9}	1.94×10^{9}	1.94×10^{9}	1.14×10^{9}
5	8×10^{8}	8.8×10^{8}	8.6×10^{8}	5.4×10^{8}
6	1.62×10^{9}	1.65×10^{9}	1.66×10^{9}	1.07×10^{8}
7	1.52×10^{9}	1.46×10^{9}	1.48×10^{9}	8.8×10^{8}
10	2.2×10^{9}	2.15×10^{9}	2.2×10^{9}	1.32×10^{9}

FUSING FLUID
TYPE (J)
72 Hr. Delay
SOLDER MASK
0 VOLTS
Insulation Resistance - OHMS

	Spec. 1	Spec. 2	Spec. 3	Spec. 4	Control#2
3	1.4×10^{11}	3.15×10^{9}	3.3×10^{8}	4.15×10^{9}	3.65×10^{10}
4	1.94×10^{11}	4.3×10^{9}	1.2×10^{9}	3.9×10^{9}	2.75×10^{10}
5	3.8×10^{10}	2.85×10^{9}	7.9×10^{8}	2.85×10^{9}	2×10^{10}
6	9.6×10^{10}	3.75×10^{9}	1.2×10^{9}	2.7×10^{9}	1.84×10^{10}
7	6×10^{10}	2.75×10^{9}	1.08×10^{9}	2.4×10^{9}	1.54×10^{10}
10	1.38×10^{11}	2.95×10^{9}	1×10^{9}	1.98×10^{9}	1.2×10^{10}

FUSING FLUID
TYPE (J)
72 Hr. Delay
SOLDER MASK
100 VOLTS
Insulation Resistance - OHMS

	Spec. 1	Spec. 2	Spec. 3	Spec. 4
3	5.6×10^{9}	4.5×10^{9}	3.6×10^{9}	
4	5.7×10^{9}	4.8×10^{9}	3.6×10^{9}	
5	4.2×10^{9}	3.75×10^{9}	2.9×10^{9}	
6	4.25×10^{9}	3.8×10^{9}	2.75×10^{9}	
7	3.75×10^{9}	3.25×10^{9}	2.35×10^{9}	
10	3.25×10^{9}	2.3×10^{9}	2×10^{9}	

FUSING FLUID
TYPE (L)
72 Hr. Delay
CONFORMAL COATED
0 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4	Control#3
3	7.25×10^{7}	6.0×10^{7}	7.5×10^{7}	6.4×10^{7}	3.3×10^{9}
4	8.9×10^{7}	7.9×10^{7}	9.6×10^{7}	8.7×10^{7}	3.3×10^{9}
5	8.9×10^{7}	6.8×10^{7}	9.5×10^{7}	9×10^{7}	2.6×10^{9}
6	1.02×10^{8}	8.7×10^{7}	1.06×10^{8}	1.08×10^{8}	3×10^{9}
7	1.04×10^{8}	9.4×10^{7}	1.07×10^{8}	1.14×10^{8}	2.2×10^{9}
10	1.18×10^{8}	1.1×10^{8}	1.06×10^{8}	1.24×10^{8}	2.15×10^{9}

FUSING FLUID
TYPE (L)
72 Hr. Delay
CONFORMAL COATED
100 VOLTS
Insulation Resistance - OHMS

	Spec. 1	Spec. 2	Spec. 3	Spec. 4
3	4.5×10^{8}	4.7×10^{8}	9.2×10^{8}	6.4×10^{8}
4	6.3×10^{8}	6.5×10^{8}	1.34×10^{9}	9.4×10^{8}
5	5.2×10^{8}	5.8×10^{8}	1.06×10^{9}	9.1×10^{8}
6	6.8×10^{8}	7.5×10^{8}	1.28×10^{9}	1.12×10^{9}
7	7.2×10^{8}	8.3×10^{8}	1.26×10^{9}	1.1×10^{9}
10	9.2×10^{8}	9.5×10^{8}	1.3×10^{9}	1.22×10^{9}

FUSING FLUID
TYPE (L)
72 Hr. Delay
SOLDER MASK
0 VOLTS
Insulation Resistance - OHMS

	Spec. 1	Spec. 2	Spec. 3	Spec. 4
3	7.0×10^{9}	8.85×10^{9}	7.45×10^{9}	7.6×10^{9}
4	5.9×10^{9}	7.5×10^{9}	7×10^{9}	7.1×10^{9}
5	4.5×10^{9}	5.8×10^{9}	5.7×10^{9}	5.9×10^{9}
6	4.05×10^{9}	5×10^{9}	5.1×10^{9}	5.1×10^{9}
7	3.5×10^{9}	4.4×10^{9}	4.35×10^{9}	4.7×10^{9}
10	2.7×10^{9}	3.45×10^{9}	3.45×10^{9}	3.65×10^{9}

FUSING FLUID
TYPE (L)
72 Hr. Delay
SOLDER MASK
100 VOLTS
Insulation Resistance - OHMS

	Spec. 1	Spec. 2	Spec. 3	Spec. 4
3	10.0×10^{9}	1.14×10^{10}	1.16×10^{10}	9.6×10^{9}
4	8.6×10^{9}	1.04×10^{10}	1.02×10^{10}	8×10^{9}
5	6.4×10^{9}	8.1×10^{9}	8.5×10^{9}	6.5×10^{9}
6	5.8×10^{9}	7×10^{9}	7.6×10^{9}	5.8×10^{9}
7	5.05×10^{9}	6.2×10^{9}	6.8×10^{9}	4.95×10^{9}
10	4.7×10^{9}	4.9×10^{9}	5.8×10^{9}	3.75×10^{9}

FUSING FLUID
TYPE (O)
72 Hr. Delay
CONFORMAL COATED
0 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4
3	1.26×10^{8}	1.46×10^{8}	1.08×10^{9}	5.8×10^{8}
4	1.69×10^{8}	1.84×10^{8}	1.2×10^{9}	6.8×10^{8}
5	1.78×10^{8}	1.94×10^{8}	1.09×10^{9}	6.8×10^{8}
6	2.1×10^{8}	2.25×10^{8}	1.08×10^{9}	7.6×10^{8}
7	2.25×10^{8}	2.4×10^{8}	1.02×10^{9}	7.5×10^{8}
10	2.15×10^{8}	2.35×10^{8}	8.9×10^{8}	7×10^{8}

FUSING FLUID
TYPE (O)
72 Hr. Delay
CONFORMAL COATED
100 VOLTS
Insulation Resistance - OHMS

Spec. 1	Spec. 2	Spec. 3	Spec. 4
9.0×10^{7}	2.57×10^{8}	8.2×10^{8}	1.2×10^{9}
1×10^{8}	3×10^{8}	9.4×10^{8}	1.27×10^{9}
1.02×10^{8}	2.85×10^{8}	8.3×10^{8}	1.18×10^{9}
1.12×10^{8}	3.05×10^{8}	9.3×10^{8}	1.22×10^{9}
1.12×10^{8}	3.05×10^{8}	9.1×10^{8}	1.16×10^{9}
1.2×10^{8}	3.05×10^{8}	8.7×10^{8}	1.16×10^{9}

FUSING FLUID
TYPE (O)
72 Hr. Delay
SOLDER MASK
0 VOLTS
Insulation Resistance - OHMS

	Spec. 1	Spec. 2	Spec. 3	Spec. 4
3	6.6×10^{8}	1.18×10^{9}	8.0×10^{8}	3.05×10^{8}
4	5.6×10^{8}	1.02×10^{9}	8.1×10^{8}	3.25×10^{8}
5	5.4×10^{8}	8.9×10^{8}	7.5×10^{8}	3.2×10^{8}
6	4.95×10^{8}	8.0×10^{8}	7.1×10^{8}	3.25×10^{8}
7	4.55×10^{8}	7.1×10^{8}	6.4×10^{8}	3.15×10^{8}
10	4.25×10^{8}	6.2×10^{8}	5.6×10^{8}	3×10^{8}

FUSING FLUID
TYPE (O)
72 Hr. Delay
SOLDER MASK
100 VOLTS
Insulation Resistance - OHMS

Spec. 1	Spec. 2	Spec. 3	Spec. 4
8.5×10^{8}	5.7×10^{8}	1.09×10^{9}	2.03×10^{9}
8.3×10^{8}	5.6×10^{8}	1.07×10^{9}	1.9×10^{9}
7.7×10^{8}	5.5×10^{8}	1.07×10^{8}	1.68×10^{9}
7.5×10^{8}	5.6×10^{8}	9.9×10^{8}	1.58×10^{9}
7.3×10^{8}	5.6×10^{8}	9.5×10^{8}	1.46×10^{9}
6.9×10^{8}	5.5×10^{8}	8.9×10^{8}	1.34×10^{9}

FUSING FLUID
TYPE (M)
72 Hr. Delay
CONFORMAL COATED
0 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4	Control#1
3	12×10^{9}	9×10^{9}	1.9×10^{10}	1.8×10^{10}	15×10^{9}
4	10.8×10^{9}	7.9×10^{9}	13.4×10^{9}	14×10^{9}	10×10^{9}
5	8.2×10^{9}	7.1×10^{9}	1.22×10^{10}	1.24×10^{10}	8.1×10^{9}
6	5.8×10^{9}	5.3×10^{9}	9.0×10^{9}	9.2×10^{9}	5.5×10^{9}
7	4.9×10^{9}	5.1×10^{9}	8.5×10^{9}	8.5×10^{9}	5.1×10^{9}
10	3.8×10^{9}	4.5×10^{9}	6.8×10^{9}	7.0×10^{9}	4.7×10^{9}

FUSING FLUID
TYPE (M)
72 Hr. Delay
CONFORMAL COATED
100 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4
3	16×10^{9}	16×10^{9}	4.6×10^{9}	12×10^{9}
4	12.3×10^{9}	12.2×10^{9}	4.5×10^{9}	10.1×10^{9}
5	1.15×10^{10}	1.07×10^{10}	4.1×10^{9}	8.15×10^{9}
6	8.2×10^{9}	8.5×10^{9}	3.2×10^{9}	6.9×10^{9}
7	7.4×10^{9}	8×10^{9}	3.3×10^{9}	6.5×10^{9}
10	7.1×10^{9}	7.3×10^{9}	3.2×10^{9}	5.8×10^{9}

FUSING FLUID
TYPE (M)
72 Hr. Delay
SOLDER MASK
0 VOLTS
Insulation Resistance - OHMS

	Spec. 1	Spec. 2	Spec. 3	Spec. 4	Control#2
3	12×10^{9}	5.8×10^{9}	9×10^{9}	8.5×10^{9}	9×10^{9}
4	8×10^{9}	4.7×10^{9}	7.9×10^{9}	7.2×10^{9}	5.5×10^{9}
5	8×10^{9}	4×10^{9}	6.45×10^{9}	5.9×10^{9}	4.6×10^{9}
6	5.9×10^{9}	3.5×10^{9}	5.6×10^{9}	5.3×10^{9}	3.4×10^{9}
7	2.6×10^{9}	3.2×10^{9}	5.9×10^{9}	5.1×10^{9}	2.9×10^{9}
10	2.2×10^{9}	2.9×10^{9}	4.1×10^{9}	3.5×10^{9}	2.2×10^{9}

FUSING FLUID
TYPE (M)
72 Hr. Delay
SOLDER MASK
100 VOLTS
Insulation Resistance - OHMS

	Spec. 1	Spec. 2	Spec. 3	Spec. 4
3	9×10^{9}	7×10^{9}	8.5×10^{9}	8.5×10^{9}
4	7.7×10^{9}		8×10^{9}	7.3×10^{9}
5	6.45×10^{9}	6.1×10^{9}	7×10^{9}	6×10^{9}
6	5.5×10^{9}	4.9×10^{9}	5.8×10^{9}	5.2×10^{9}
7	5.5×10^{9}	4.9×10^{9}	5.5×10^{9}	4.3×10^{9}
10	4.6×10^{9}	4.3×10^{9}	4.9×10^{9}	4.7×10^{9}

FUSING FLUID
TYPE (N)
72 Hr. Delay
CONFORMAL COATED
0 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4
3	2.4×10^{7}	* 2.8×10^{10}	6.5×10^{6}	12.3×10^{6}
4	* 7.5×10^{11}	9×10^{6}	* 3.7×10^{10}	2.3×10^{7}
5	1.44×10^{7}	2.75×10^{7}	12×10^{6}	4.25×10^{7}
6	3.3×10^{7}	5.8×10^{7}	2.4×10^{7}	4.3×10^{7}
7	3.5×10^{7}	5.8×10^{7}	4×10^{7}	7.2×10^{7}
10	4.0×10^{7}	7.5×10^{7}	5.5×10^{7}	9.0×10^{7}

FUSING FLUID
TYPE (N)
72 Hr. Delay
CONFORMAL COATED
100 VOLTS
Insulation Resistance - OHMS

Spec. 1	Spec. 2	Spec. 3	Spec. 4
2.8×10^{8}	1.6×10^{8}	13×10^{7}	13.5×10^{7}
* 7.2×10^{12}	* 17.5×10^{12}	2.3×10^{8}	2.1×10^{8}
2.8×10^{8}	3.15×10^{8}	3.25×10^{8}	2.75×10^{8}
2.5×10^{8}	3.2×10^{8}	2.8×10^{8}	2.8×10^{8}
2.9×10^{8}	3.4×10^{8}	3.4×10^{8}	3.1×10^{8}
3.7×10^{8}	4.5×10^{8}	5.3×10^{8}	4.3×10^{8}

* Operator Error

FUSING FLUID
TYPE (N)
72 Hr. Delay
SOLDER MASK
0 VOLTS
Insulation Resistance - OHMS

DAY	Spec. 1	Spec. 2	Spec. 3	Spec. 4
3	5.5×10^{9}	5.5×10^{9}	3.7×10^{9}	5.2×10^{9}
4	4.7×10^{9}	4×10^{9}	3.1×10^{9}	* 5.2×10^{12}
5	3.8×10^{9}	3.2×10^{9}	3×10^{9}	3.45×10^{9}
6	3.1×10^{9}	2.6×10^{9}	2.4×10^{9}	2.7×10^{9}
7	3.1×10^{9}	2.4×10^{9}	2×10^{9}	2.4×10^{9}
10	2.1×10^{9}	1.7×10^{9}	1.6×10^{9}	1.8×10^{9}

FUSING FLUID
TYPE (N)
72 Hr. Delay
SOLDER MASK
100 VOLTS
Insulation Resistance - OHMS

Spec. 1	Spec. 2	Spec. 3	Spec. 4
3.1×10^{9}	2.7×10^{9}	2.8×10^{9}	2.7×10^{9}
2.6×10^{9}	2.2×10^{9}	* 3×10^{11}	2.2×10^{9}
2.15×10^{9}	1.98×10^{9}	2×10^{9}	1.63×10^{9}
1.8×10^{9}	1.9×10^{9}	1.7×10^{9}	1.6×10^{9}
1.6×10^{9}	1.5×10^{9}	1.6×10^{9}	1.4×10^{9}
1.3×10^{9}	1.3×10^{9}	1.3×10^{9}	1.2×10^{9}

* Operator Error

TABLE V

FORMULA FOR LINEAR REGRESSION LINES OF RESISTANCE VS TIME AND ANALYSIS OF LINE SLOPES
72 HOUR DELAY BEFORE FUSING FLUID REMOVAL ("A","B",AND "C" FUSING FLUIDS)

CONDITIONS	"A" FUSING FLUID	"B" FUSING FLUID	"C" FUSING FLUID
0 Volts Electrical Stress, Conformally Coated	log R = .0425T+.571	log R = .00735T+.456	log R =-.0418T+.679
100 Volts Electrical Stress, Conformally Coated	log R = .563T-.119	log R = .0293T+.5968	log R =-.0316T+1.25
0 Volts Electrical Stress, Solder Mask Coated	log R = -.038T+1.625	log R =-.00383T+.3125	log R =-.0556T+.453
100 Volts Electrical Stress, Solder Mask Coated	log R = -.01133T+.388	log R = .0127T+.381	log R =-.038T+.958
$\bar{X}$ Slopes	.1178	.005205	- .04175
σ Slopes	.2573	.01551	.00879
$\bar{X} + 3\sigma$	.8897	.05175	- .01538
$\bar{X} - 3\sigma$	- .6542	- .04134	- .06811
Trend of Slopes Is	Positive	Positive	Negative

TABLE VI

FORMULA FOR LINEAR REGRESSION LINES OF RESISTANCE VS TIME AND ANALYSIS OF LINE SLOPES
168 HOUR DELAY BEFORE FUSING FLUID REMOVAL ("A","B", AND "C" FUSING FLUIDS)

CONDITIONS	"A" FUSING FLUID	"B" FUSING FLUID	"C" FUSING FLUID
0 Volts Electrical Stress, Conformally Coated	log R = .0296T+.3103	log R = .0357T+.26	log R = -.043T+.75
100 Volts Electrical Stress, Conformally Coated	log R = .0079T+.859	log R = .0255T+.472	log R = -.027T+.673
0 Volts Electrical Stress, Solder Mask Coated	log R = -.145T+1.38	log R = -.1044T+1.18	log R = -.147T+1.04
100 Volts Electrical Stress, Solder Mask Coated	log R = -.122T+2.05	log R = -.0868T+1.07	log R = -.137T+1.612
$\bar{X}$ Slopes	-.05738	-.0325	-.08850
σ Slopes	.07694	.06351	.05391
$\bar{X} + 3\sigma$	.1734	.1580	.07324
$\bar{X} - 3\sigma$	-.2882	-.2230	-.2502
Trend of Slopes Is	Negative	Negative	Negative

TABLE VII

FORMULA FOR LINEAR REGRESSION LINES OF RESISTANCE VS TIME AND ANALYSIS OF LINE SLOPES
72 HOUR DELAY BEFORE FUSING FLUID REMOVAL ("F","I",AND "K" FUSING FLUIDS)

CONDITIONS	"F" FUSING FLUID	"I" FUSING FLUID	"K" FUSING FLUID
0 Volts Electrical Stress, Conformally Coated	log R = -.0919T+.988	log R = -.0948T+.777	log R =-.0747T+.884
100 Volts Electrical Stress, Conformally Coated	log R = -.0857T+.905	log R = -.0843T+.784	log R =-.101T+1.206
0 Volts Electrical Stress, Solder Mask Coated	log R = -.103T+.902	log R = -.0804T+.531	log R =-.0822T+.781
100 Volts Electrical Stress, Solder Mask Coated	log R = -.0768T+.714	log R = -.0697T+.662	log R =-.0631T+.563
$\bar{X}$ Slopes	- .0894	- .0823	- .0803
σ Slopes	.00953	.00898	.0138
$\bar{X} + 3\sigma$	- .0607	- .0554	- .0389
$\bar{X} - 3\sigma$	- .118	- .109	- .122
Trend of Slopes Is	Negative	Negative	Negative

TABLE VIII

FORMULA FOR LINEAR REGRESSION LINES OF RESISTANCE VS TIME AND ANALYSIS OF LINE SLOPES

72 HOUR DELAY BEFORE FUSING FLUID REMOVAL ("J","L", AND "O" FUSING FLUID)

CONDITIONS			
0 Volts Electrical Stress, Conformally Coated	log R = .0782T-.455	log R = .0296T-.209	log R = .0133T+.5299
100 Volts Electrical Stress, Conformally Coated	log R = .0321T-.117	log R = .0555T+.559	log R = .00572T+.595
0 Volts Electrical Stress, Solder Mask Coated	log R = -.00618T+.759	log R = -.0538T+1.03	log R = -.0232T+.883
100 Volts Electrical Stress, Solder Mask Coated	log R = -.0402T+.784	log R = -.0508T+1.146	log R = -.00698T+.962
$\bar{X}$ Slopes	.0160	-.00513	-.00279
σ Slopes	.0441	.0482	.0138
$\bar{X} + 3\sigma$	.148	.139	.0387
$\bar{X} - 3\sigma$	-.1163	-.150	-.0443
Trend of Slopes Is	Positive	Negative	Negative

TABLE IX

FORMULA FOR LINEAR REGRESSION LINES OF RESISTANCE VS TIME AND ANALYSIS OF LINE SLOPES

72 HOUR DELAY BEFORE FUSING FLUID REMOVAL ("M" AND "N" FUSING FLUIDS)

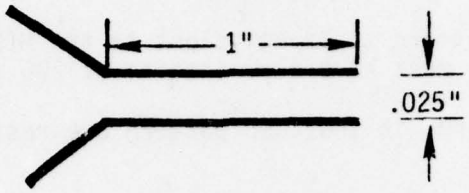
CONDITIONS	"M" FUSING FLUID	"N" FUSING FLUID	
0 Volts Electrical Stress, Conformally Coated	log R = -.0603T+1.281	log R = .0758T+.0649	
100 Volts Electrical Stress, Conformally Coated	log R = -.0423T+1.116	log R = .055T+.119	
0 Volts Electrical Stress, Solder Mask Coated	log R = -.0632T+1.089	log R = -.0616T+.838	
100 Volts Electrical Stress, Solder Mask Coated	log R = -.0376T+1.00	log R = -.0484T+.554	
$\bar{X}$ Slopes	-.0509	.0052	
σ Slopes	.0111	.0608	
$\bar{X} + 3\sigma$	-.0176	.188	
$\bar{X} - 3\sigma$	-.0841	-.177	
Trend of Slopes Is	Negative	Positive	

TABLE X

MIL-P-28809 IONIC CONTAMINANTS TEST

CLEANING DELAY	RESISTIVITY OHM-CM x 10^6	RESISTIVITY OHM-CM x 10^6	RESISTIVITY OHM-CM x 10^6	BEGINNING RESISTIVITY OF WASH SOLUTION OHM-CM x 10^6
	"A" FUSING FLUID	"B" FUSING FLUID	"C" FUSING FLUID	
72 Hour				
Specimen 1	9.4	9.8	24.6	
Specimen 2	8.0	10.8	30	57.0
Specimen 3	8.5	9.8	30	
168 Hour				
Specimen 1	3.4	4.6	10.3	
Specimen 2	3.1	3.3	9.1	24.0
Specimen 3	3.1	6.0	12.0	
	"F" FUSING FLUID	"I" FUSING FLUID	"K" FUSING FLUID	
72 Hour				
Specimen 1	7.2	17.4	20.0	
Specimen 2	7.0	17.5	21.0	20.0
Specimen 3	6.6	17.4	19.0	
	"J" FUSING FLUID	"L" FUSING FLUID	"O" FUSING FLUID	
72 Hour				
Specimen 1	2.5	4.9	4.5	
Specimen 2	2.0	5.5	3.2	> 25.0
Specimen 3	3.4	5.4	5.0	
	"M" FUSING FLUID	"N" FUSING FLUID		
72 Hour				
Specimen 1	15.0	- - -		
Specimen 2	14.8	5.4		27.0
Specimen 3	13.5	4.7		

EQUILIBRATION OF COMB PATTERN TO MIL-P-55110 TRUMPET PATTERN



MIL-P-55110 TRUMPET PATTERN

1. Number of resistance squares

$$\frac{1.00"}{.025"} = 40 \text{ squares}$$

2. Assume the squares are resistors connected in parallel

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots \frac{1}{R_{40}}$$

$$\frac{1}{R_T} = \frac{40}{R_S}$$

Where $R_T = 500 \times 10^6$ ohms per MIL-P-55110

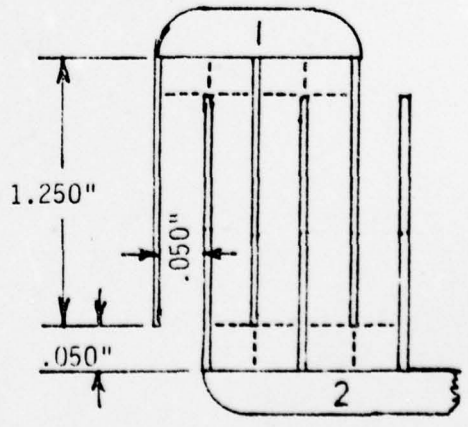
R_S = resistance of each square.

3. $R_T = \frac{R_S}{40}$

4. $500 \times 10^6 = \frac{R_S}{40}$

$R_S = 200 \times 10^8$ ohms

Resistance measured portion of comb pattern specimen



5. Number of resistance squares

$\frac{1.250"-.050"}{.050"}$ x 5 + 8 corner squares at the ends of the conductors = 128 squares.

6. For this comb pattern to be eqivalent to the MIL-P-55110 trumpet pattern, each square must have a resistance of 200×10^8 ohms.

7. Assumes the squares in the comb pattern are resistors in parallel

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots \frac{1}{R_{128}}$$

$$\frac{1}{R_T} = \frac{128}{R_S}$$

where

R_T = total resistance

R_S = 200×10^8 ohms

8. $$R_T = \frac{R_S}{128}$$

9. $$R_T = \frac{200 \times 10^8}{128}$$

$$R_T \approx 1.5 \times 10^8 \text{ ohms}$$

10. Therefore, the comb pattern specimen has a MIL-P-55110 equivalent value of 1.5×10^8 ohms. Any resistance value less than this during testing was a failure.

MATERIALS

1. Circuit Board Material
   FL-GF, .062, C1/1

2. Solder Mask
   Photocircuits Co.
   PC-401
   Epoxy type

3. Conformal Coating
   Conap, Inc.
   CE-1155
   Polyurethane type

4. Electrical Leads
   200AS100-18 wire

5. Wire Solder
   WRP-2

6. Fusing Fluids
   The identity of the fusing fluids is available only to the funding source of this study because of their proprietary nature.

EQUIPMENT

1. Temperature and Humidity Chamber
   Blue M Co.
   Model FR-256BP

2. Power Supply
   Lambda Co.
   Model LP-534-FM

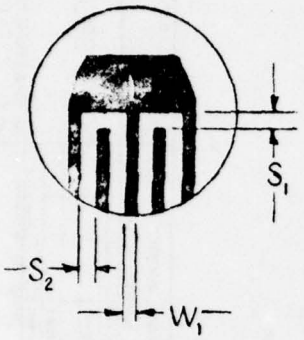
3. Megohm Bridge
   General Radio Co.
   Model 1644-A

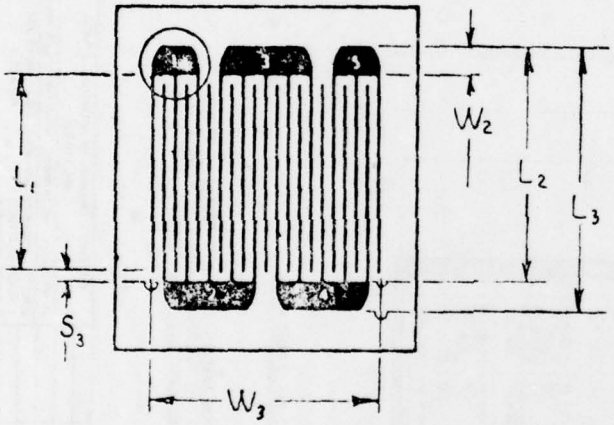
4. Vapor Cleaner
   Acra Electric Corp.
   Spee Degreaser Model D-3

5. Infra-Red Solder Fusing Machine
   Research, Inc.
   Model 4384

6. MIL-P-28809 Apparatus as described in Naval Avionics Center Materials Research Report 3-78.

APPLICATION		REVISIONS			
NEXT ASSY	USED ON	LTR	DESCRIPTION	DATE	APPROVED





TABLE

CODE	DIM.	TOL.
L_1	1.250	+.000 −.004
L_2	1.550	+.000 −.004
L_3	1.750	+.000 −.004
S_1	.050	+.004 −.000
S_2	.050	+.004 −.008
S_3	.050	+.004 −.008
W_1	.025	+.000 −.004
W_2	.200	+.000 −.004
W_3	1.525	+.000 −.004

REV STATUS OF SHEETS	REV																					
	SHEET	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

INTERPRET DRAWING IN ACCORDANCE WITH MIL-STD-100

DIMENSIONS ARE IN INCHES

UNLESS OTHERWISE SPECIFIED, TOLERANCES ARE:
3 PLACE DECIMALS ±
2 PLACE DECIMALS ±
ANGLES ±

NAVAL AVIONICS FACILITY
INDIANAPOLIS, IND. 46218

PROJ ENGR	H. T. Hobson	5-12-78
ENGINEER		
CHECKED		
PREPARED	J. L. Wasko	4-06-78

APPROVED FOR THE COMMAND

_____ 19___

MATL ENGR

CMPNT ENGR

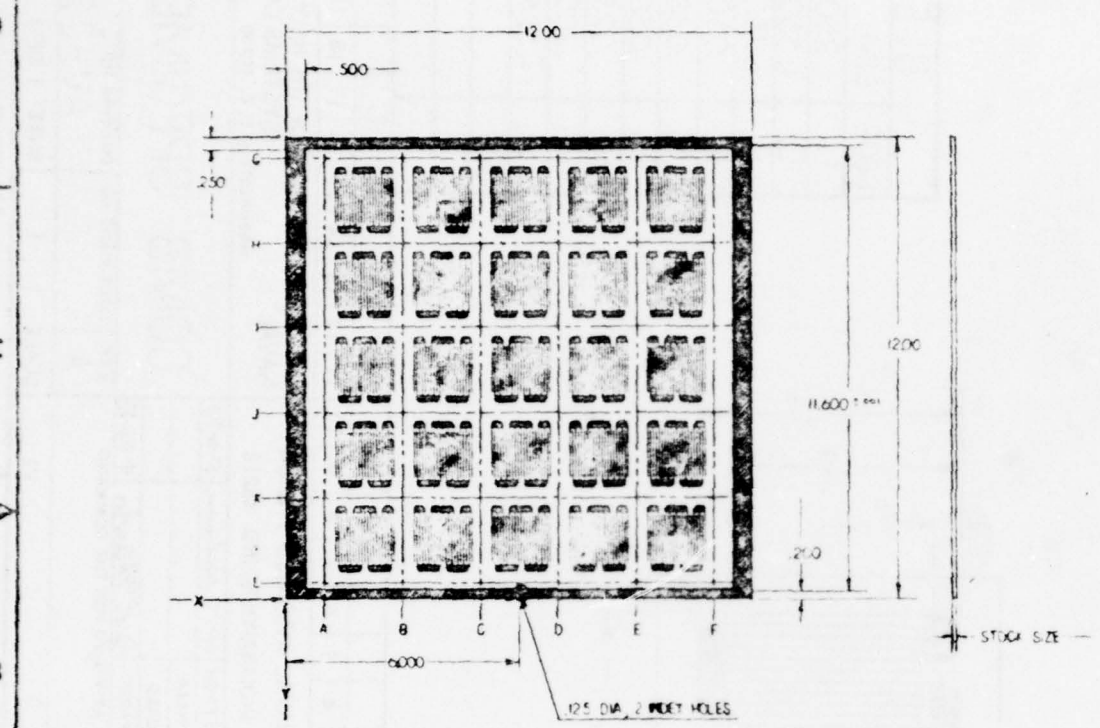
DEPARTMENT OF THE NAVY
NAVAL SYSTEMS COMMAND
WASHINGTON, D. C. 20360

COMB SPECIMEN

SIZE	CODE IDENT NO.	DRAWING NO.
A		AV-22107

SCALE 1 : 1 SHEET 1 OF 1

SND NAFI 3602/149 (1-73)



REV STATUS OF SHEETS	REV					
	SHEET	1	2	3	4	5

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

INDEX HOLE LOCATIONS		
HOLE #	X	Y
1	6.000	0.200
2	6.000	11.800

CUT OFF ℄ COORDINATES		
℄	X	Y
A	1.000	
B	3.000	
C	5.000	
D	7.000	
E	9.000	
F	11.000	
G		11.625
H		9.375
J		7.125
J		4.875
K		2.625
L		0.375

NOTES:
1. THIS PRODUCTION MASTER HAS BEEN DESIGNED FOR FABRICATION BY THE SUBTRACTIVE PROCESS, FROM BASE MATERIAL CLAD WITH 1 oz / SQ FT COPPER FOIL.

	INTERPRET DRAWING IN ACCORDANCE WITH MIL STD 100	NAVAL AVIONICS FACILITY, INDIANAPOLIS IND 46218
	DO NOT SCALE THIS DRAWING, DIMENSIONS ARE IN INCHES	DRAFTSMAN [illegible] 15-15-78
	UNLESS OTHERWISE SPECIFIED, TOLERANCES ARE 3 PLACE DECIMALS ± ANGLES ± 2 PLACE DECIMALS ±	ENGINEER
	REMOVE BURRS BREAK SHARP EDGES MAX	CHECKED
	MATERIAL COPPER CLAD GLASS EPOXY LAMINATE MIL-P-13949, FL-GF-.062-C-½-R T B	FILE NUMBER [illegible] 4-0-78
NEXT ASSY USED ON APPLICATION		APPROVED FOR THE COMMAND 19

DEPARTMENT OF THE NAVY
WASHINGTON D C

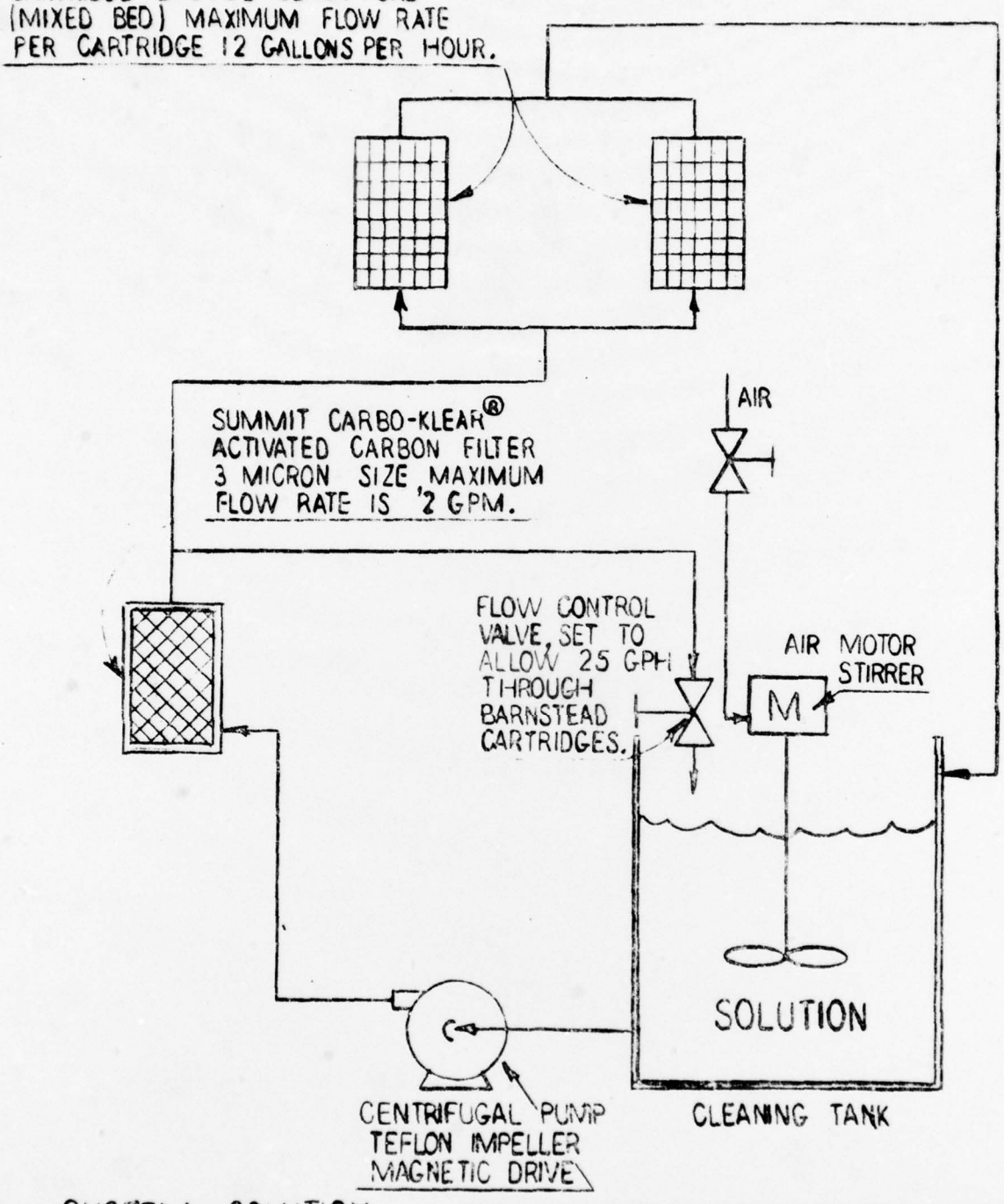
COMB SPECIMEN (AV22107)

SIZE	CODE IDENT NO	DRAWING NO
C		AV 22109

SCALE 1 : 1 SHEET

A-27

NAC TR-2259



SYSTEM SOLUTION

75% 2-PROPANOL
25% DEIONIZED WATER
APPROXIMATELY 12 GALLONS

DRAWN BY J. Washon	CLEANING SYSTEM SCHEMATIC		
PROJ. ENGR. R E Martz	SIZE A	CODE IDENT NO. 02387	DRAWING NO. AV 21922
DATE 8-2-77	SCALE ~	REV	SHEET 1 of 1

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265 1
410 1
415 1
423 1
443 1
700 1
710 2
712 1
713 1
714 3
900 1

Naval Avionics Center (NAC Report TR-2259)

Deleterious Effect of Fusing Fluids on Printed Wiring Boards,by David O. Pond, 9 May 1979

UNCLASSIFIED, 56 p.

This study identified the corrosive effects of fusing fluids and fusing fluid residues on printed wiring boards subjected to electrical stress in a humid environment at elevated temperature. The effect of varying delay times between solder fusing and cleaning of fusing fluid residues for three fusing fluids was studied. The

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